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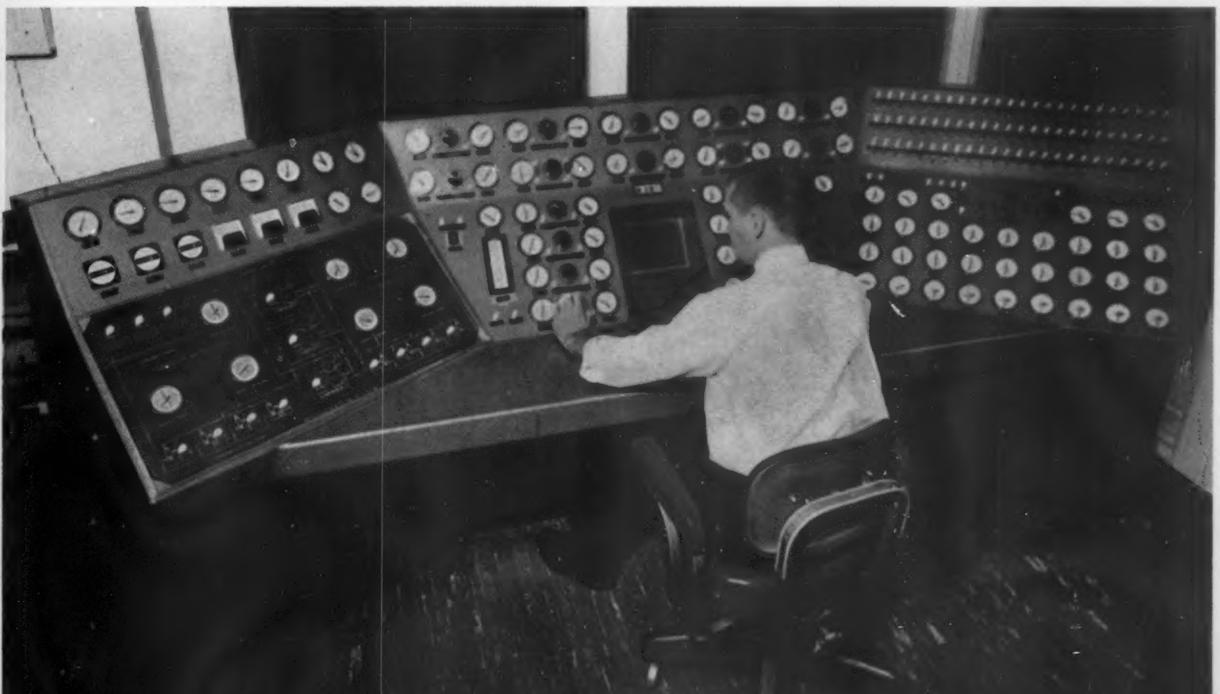
Heating • Refrigerating • Air Conditioning • Ventilating

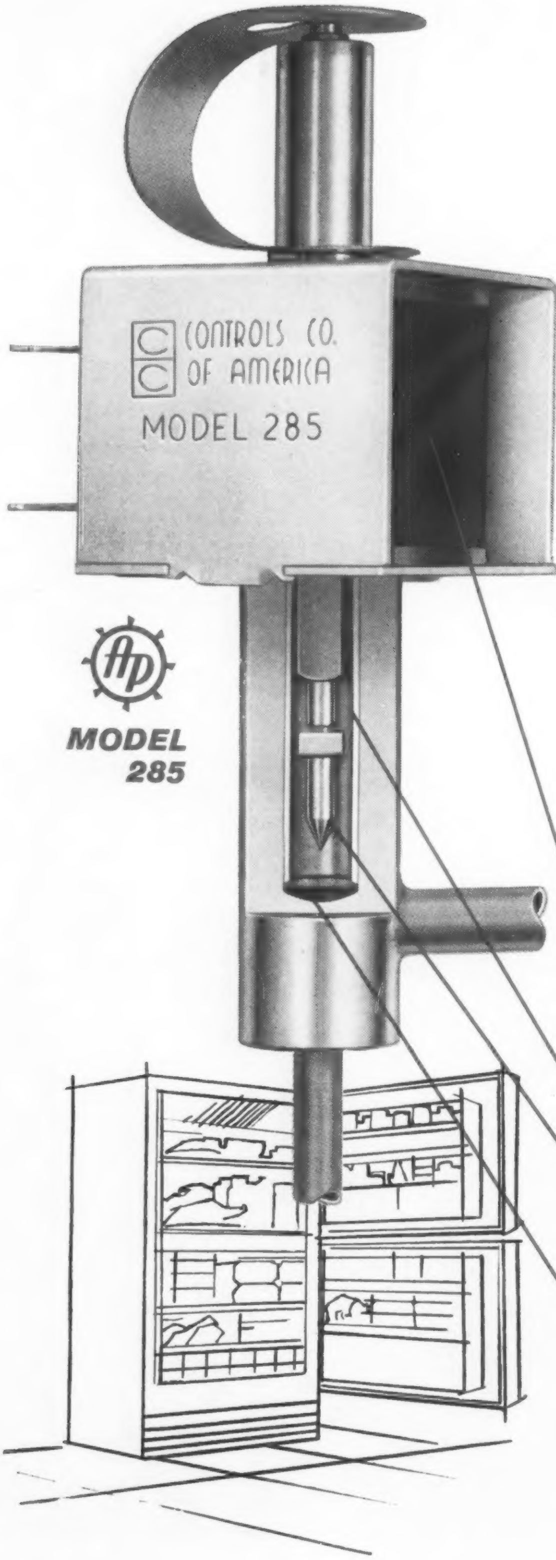
AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS



All within easy access of the supervisor, here shown seated at the console control center of the National Bank of Detroit building, are the controls, meters and diagrams of the complete air conditioning system. The screen before the supervisor has 50 color diagrams covering the fan and control systems, the refrigerant circuits, pump layouts and similar guides to operation. (See also page 59)

SEPTEMBER 1960

Open and shut case for the only valve that offers "nonstick" dependability for refrigerators utilizing hot gas defrosting



This new Model 285 hot gas defrost valve always opens and closes on schedule, making automatic defrosting of domestic refrigerators and home freezers absolutely foolproof. Everything possible has been done by Controls Company's engineers (see cutaway) to prevent "hanging-up" and the food spoilage that results from such valve defection. That's why if you're considering hot gas defrosting, your opening move is to investigate the new A-P Model 285. Write today for full facts.

Here's how A-P engineers solved a sticky problem

SOLENOID lifts needle . . . gravity plus pressure drop closes it. Solenoid coil is encapsulated with a layer of EPOXY resin — moisture resistant for long life. Coils available with open yoke (shown) or total metal enclosure.

PLUNGER TUBE is stainless steel with "mirror-smooth" internal surface finish. Highest corrosion resistance.

STAINLESS STEEL NEEDLE slides smoothly without sticking. Head of needle is radiused to give one-point contact in open position. Edges of plunger are rounded for minimum friction and long life.

VALVE INTERIOR is polished to within 20 rms for minimum coefficient of friction. Seat as well as needle is of stainless steel adding to no-stick, long-life operation.

MISCELLANEOUS SPECIFICATIONS: 3/32″ orifice. 225 lb. lift. 200 cc/minute max. leak at 200 lb. dry air. Coils for 115- or 230-volt, 60-cycle service.

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SEPTEMBER 1960

VOL. 2 NO. 9

ASHRAE JOURNAL

OFFICIAL PUBLICATION

Formerly Refrigerating Engineering including Air Conditioning, and incorporating the ASHAE Journal.

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THE HIGHER CONFORMITY

Procrustes, according to the ancient Greeks, maintained a sort of hostelry where guests were forced to fit exactly the length of the bed he provided. Too tall; chop off their feet. Too short; stretch them to fit. But, above all, they must conform with the specifications.

There is much Procrusteanism around us today. Individuals are judged (better or worse) by the degree to which they conform with an established pattern of current thought or behavior. Causes are considered (worthy or unworthy) by the principle of conformity. Is not America becoming a sort of mass of sameness where each town looks alike, each community espouses the same educational, social and recreational objectives, each child is automatically conditioned as to "desirable" attitudes of work and play and right-thinkingness becomes a national obsession?

Now there is real strength in unity and for the planners' purposes this may be all to the good; but it does stifle originality, minimize character development and presuppose some touch of active omniscience for more mortals than have ever before been gifted similarly.

We think essential truth is quite as likely to be found in differences as in agreements. Further, we think that any complete agreement is subject to change in only one possible way and that is toward disagreement.

Engineers, however well they may recognize the validity of this principle, tend to cling to certainties rather than to seek uncertainties; yet it is in the realm of uncertainties that progress, if it is ever to be encountered, must lie. The long record of technical accomplishments follows the narrow trail of skeletons of dead ideas that could not endure the principle of change.

Where are the dinosaurs, the pterodactyls, the brontosauri?

Where are the clipper ships, the muzzle loading muskets, the Corliss engines, natural ice refrigeration and punkahs?

Who would like to buy a nice new Model T, a sad iron, tasty dry beans or old fashioned pemmican?

Procrustes 'll git ya eff ya don' watch out.

Edward R Searles
Editor

All these appliance manufacturers—and more besides*—add *quality* to their products with Ranco Controls. Specifically engineered for the individual application, Ranco Controls insure perfect performance under all service conditions.

Ranco leadership is no accident. It's the result of product quality, research and service—plus 47 years of specialization in control manufacturing.

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*Policies of some companies prohibit the use of their trade names in advertisements other than their own. Therefore, this list is only representative of the many manufacturers who specify Ranco Controls.

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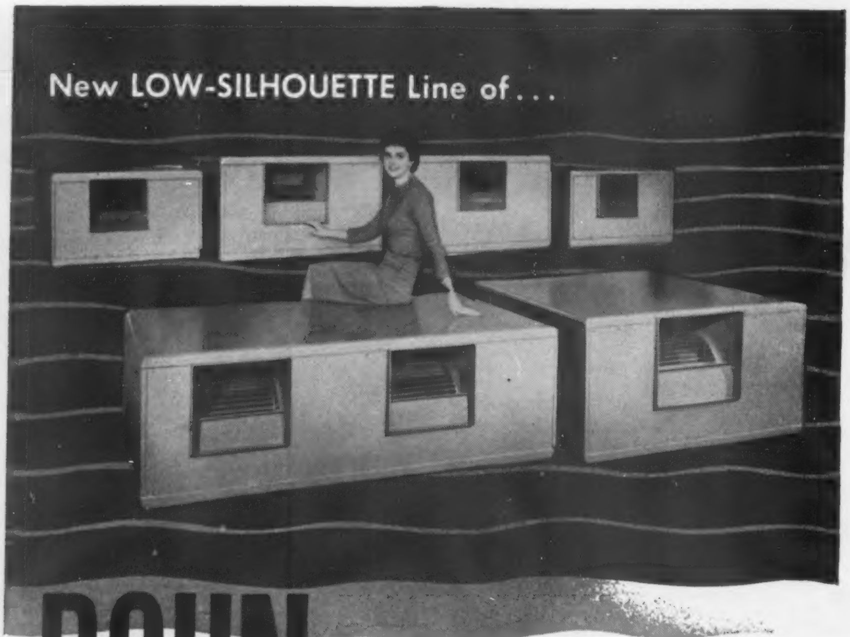

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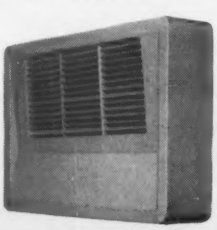
*Modern discharge plenum with double deflection grille and the fixed inlet grille are both offered as optional accessories.



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Now that you mention IT—

BUT THEY ARE!

To the Editor:

In the April 1960 issue of the JOURNAL on your They Wanted to Know page, you published a letter regarding the question of "Why aren't refrigerators equipped with casters?"

Hotpoint refrigerators in many models have been equipped with rollers since 1955 and many people are enjoying this feature because of the ease of moving for decorating and cleaning.

J. F. CARROLL, Manager
Refrigeration Product Planning

Hotpoint Company
Chicago, Ill.

MAKING IT HOT

To the Editor:

For approximately 15 years a committee at the Massachusetts Institute of Technology has been engaged in solar energy research with particular emphasis upon space heating. Recently, in the March 1960 ASHRAE JOURNAL, there appeared "To Practical Solar Heat" by Henry E. Voegeli. This article presents, in our opinion, some rather distorted and misleading statements which, unless corrected, can lead to erroneous impressions on the part of readers of the JOURNAL.

The reader may well be confused by what is referred to as "base information" on the first page. What is twice referred to as "Langley days", 700 or 200, should be "Langleys per day" or calories per cm² per day, since a Langley has the dimensions of energy per unit area. Also, reference to "600 Langley days per sq ft per day" is wholly ambiguous. Apparently again he means "Langleys per day",—having nothing to do with sq ft. And his "50 Langley days per hr" must mean "50 Langleys per hr", since the conversion factor he used, 3.68, converts from calories/cm² to Btu/ft². More significant, the assumption that the 8-summer-month average sunshine is 600 Langleys per day is overly optimistic and profoundly affects conclusions concerning economic feasibility of any proposed system for using solar energy. A value of 350 to 400 is more typical of data given in "Climatological Data"; and the validity of the assumption of an 8-month, 12-hr sunlit day is also in question for most climates.

To say that "the natural temperature of absorbed solar heat is of little use" is extraordinarily confusing. Words that have no meaning to the scientist or engineer can not be truly helpful to others. Unfocused sunlight falling on


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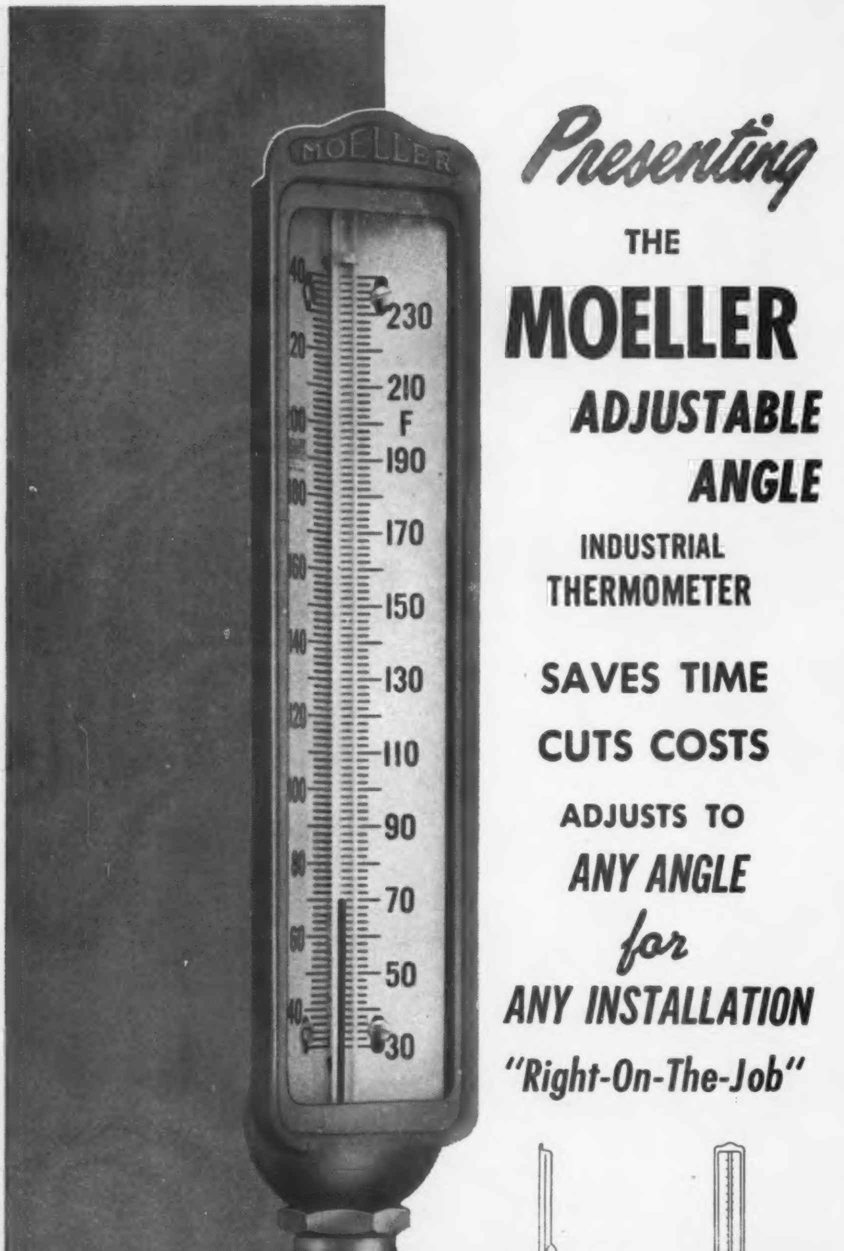

a flat surface can produce temperatures varying from room temperature to above 800 F, depending on the treatment of the surface; and who is to say what kind of treatment is "natural"? To say that temperatures obtained without focusing devices are too low for space heating misleads the reader—unless he is at the same time told that a large group of engineers thinks otherwise after making economic studies of non-focusing and focusing collectors. That it is "expedient to obtain a higher temperature by concentrating . . . ." is entirely a matter of personal opinion of the writer, unsubstantiated by a large body of literature on the subject. To use "ordinary fuel tanks buried underground, encased in reinforced concrete" for storing water at 400 psi is subject to question.

The statement is made that "because of (dryness of surrounding earth), the relatively high temperature heat . . . . will penetrate only a few inches". Without arguing the meaning of the phrase "penetrate—inches", the following is presented concerning heat loss from buried tanks. Bone-dry soil has a thermal conductivity of around 0.075 Btu/ft^{2}hr/F/ft, or if very rocky or pebbly, several times this. A sphere at temperature T_1, buried deeply in earth which has a distant temperature of T_2, will, after reaching equilibrium, lose heat at the same rate as the transfer rate between two parallel plates, at T_1 and T_2, each of area equal to that of the sphere and separated by a distance equal to the sphere radius, with the space between filled with the soil in question. For a 6000 gal tank at 470 F this loss is not inconsiderable (of the order of 70,000 Btu/day for best soil); during the period of approach to equilibrium the loss is higher.

It is suggested in the article that for a house requiring 144 x 10^6 Btu, 40 x 10^6 be stored in water tanks and the rest be extracted from the ground with a heat pump. It is also suggested that moisture will return to the previously dried earth at just the right time to change the soil from a good insulator, while solar energy is being stored, to a good conductor when the heat pump is trying to drain energy from the soil. This is an expression of a hope, not a probability. The practicality of extracting 104 x 10^6 Btu from the earth is open to question, as is the amount of equipment for collection and storage of solar energy which is to supply only 28% of the heating demand. Long-time and short-time storage of solar energy have been studied carefully by various groups including our own. None of the quantitative analyses of heating cycles supports the conclusion that it will pay to build two 6000 gal pressure tanks to hold water at 470 F, plus a power-positioned cone collector; connected by a high-pressure piping system to save 40 x 10^6 Btu/year—obtainable from about 440 gal of fuel oil. The first M.I.T. solar house stored March to November heat for winter use, as suggested in the present article, but not because it was considered economically sound to do so; various aspects of solar collector design were being studied. Both calculations and experimental results supported the conclusion that summer storage of winter heat is, economically, absurd.

The desirability of a 50 ft diam inverted cone for solar energy collection is questionable. Construction of a fo-

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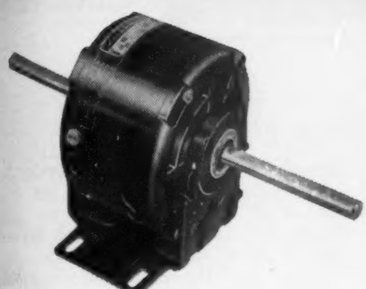
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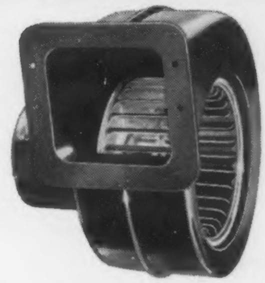
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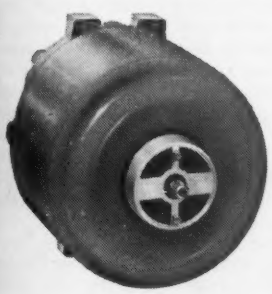
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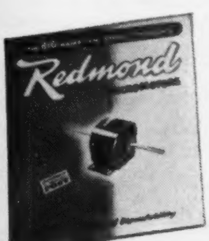

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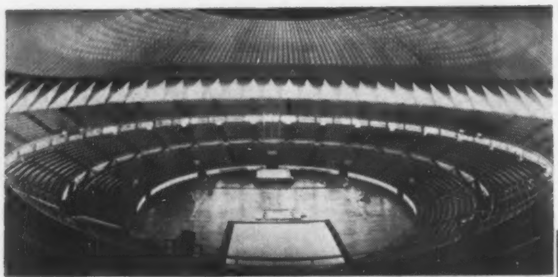
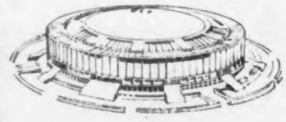
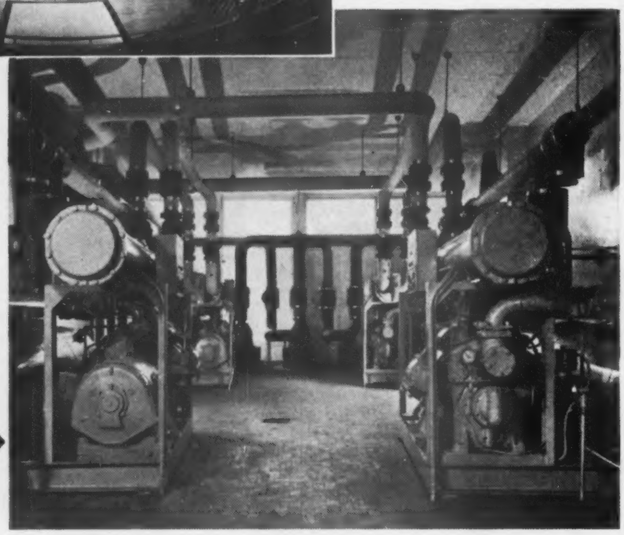
Olympic Sports Palace in Rome Cooled by Vilter Refrigeration





Exterior view of Coni Sports Palace.

Interior view of the beautiful Sports Palace (Palazzetto dello Sport) with seating capacity for 15,000, conceived by Annibale Vitellozzi and built by Pier Luigi Nervi. Boxing, basketball and fencing are among the events held here.



View of the four separate Refrigerant 22 water chilling units installed in the 1960 Olympics Coni Sports Palace in Rome. These units each incorporate a Vilter 8-cylinder VMC compressor.

● Among the handsome architecture found at the 1960 Olympics in Rome is the small Palazzetto dello Sport, an all-weather sports palace built to seat 15,000 spectators. This inspiration in modern concrete form is matched by the latest innovations in air conditioning to provide comfort for athletes and fans alike.

The cooling system, custom-designed by Vilter's Italian distributor, Dell'Orto Chieregatti, provides 1,300 tons of refrigeration capacity, of which 450 tons is produced by a central system, and the remaining capacity is supplied by well water. Four self-contained water chilling units are installed in the central refrigeration station. Each chilling unit has a Vilter 8-cylinder VMC Refrigerant 22 Compressor.

This is another example of the world-wide acceptance of Vilter refrigeration equipment. The dependable performance of Vilter VMC compressors is the result of tireless engineering improvements: built-in capacity reduction, precision manufacturing techniques, painstaking inspection, careful assembly, and factory run-in tests.

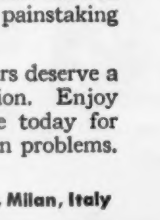
Among the champions at the Olympics, Vilter compressors deserve a gold medal in their own field for efficient, reliable operation. Enjoy trouble-free Vilter equipment in your installation. Write today for helpful counsel about your air conditioning and refrigeration problems.

Sold and installed by Vilter Distributor, SPA Dell 'Orto Chieregatti, Milan, Italy

Vilter® refrigeration air conditioning

The Vilter Manufacturing Company
Milwaukee 7, Wisconsin

Air Units • Ammonia and Freon Compressors • Booster Compressors Baudelot Coolers • Water and Brine Coolers • Blast Freezers Evaporative and Shell and Tube Condensers • Pipe Coils Valves and Fittings • Pakice and Polarflake Ice machines.



Write for Bulletin 820 to The Vilter Manufacturing Company, Dept. AR-604 2217 South First Street Milwaukee 7, Wisconsin

cusable device of this size in any area subject to high winds would certainly not be cheap or easy. Wind-tunnel studies have been made in Russia to determine the optimum size of focusing collectors, and Arthur D. Little has also made a study; the optimum is below 50 ft.

The statements discussed above are only the most conspicuously questionable ones in Mr. Voegeli's article. It is hoped that in challenging them we will help to clarify this subject in the minds of your readers.

LAWRENCE B. ANDERSON
Chairman
Committee on Space Heating with Solar Energy
Massachusetts Institute of Technology
Cambridge, Mass.

NOT A GOOD CRITERION

To the Editor:

Agreed, it would have been better to say Langley units per sq ft per day instead of Langley days, in my "To Practical Solar Heat", although the result is the same. The expression "ly/day" and the values to which Mr. Anderson objects were taken from a paper by Sigmund Fritz, U. S. Weather Bureau, published in Heating and Ventilating, January 1949.

Claiming superiority for a moving collector normal to the sun, over a fixed flat plate collector, apparently struck a nerve as may be expected from strong adherents of the fixed plate method. Mr. Anderson mentions temperatures to above 800 F in unfocused sunlight on a flat surface. Solar heat collectors in Florida get only about 190 F. Much will be learned about these things, therefore debate seems useless.

In my opinion, the heat loss from the storage tanks to the earth as illustrated by Mr. Anderson with the familiar formula is, at best, only theory. Experience with the behavior of heat in slab type radiant heating systems, using the earth as a heat sink in refrigeration seems to belie that theory.

There is a great deal of "hope" in the system I designed and explained in my article but it is based on related practical experience and what has been written by eminent authorities on ground source and sink heat pumps. The experience with low temperature heat storage at M.I.T. is not a good criterion.

As to the practicability of collector cones 50 ft in diam. Experience will prove whether they should be larger or smaller. Mr. Anderson may be right that they should be smaller. The reflector on Mont Louis in France is reported to be equivalent to 50 ft diam.

H. E. VOEGELI
Development Engineer
American Brass Co.
Waterbury, Conn.

NEXT MONTH—

- **Noise suppression in oil burners**
- **Another report on the Urbana homes**
- **Refrigeration where there is no gravity**

Late news highlights

Young engineers

According to a survey by the Engineering Manpower Commission of Engineers Joint Council, 82% of engineering graduates had definite plans, and another 11% had job offers they were considering as of May 20. Plans for prospective graduates were divided as follows: 62% with jobs, 11.3% considering jobs, 8.0% entering military service, 10.1% entering graduate studies, 1.2% with other specific plans. In all cases, these figures do not vary more than 1½% from a comparable 1959 survey.

Electric heat facts

"New Statistics on the Electric Heating Industry" is the designation of the second in a series of releases relating to the heating equipment industry by the U. S. Department of Commerce, Washington 25, D. C. This report is said to contain information, not heretofore available from any source, concerning dollar value of shipments and output rating totals in Btu/hr.

TRRF authorizes contracts

Refrigeration Research Foundation has authorized seven 1960-1961 projects involving granted continuance of funds. These are: *Refrigerated Storage of Canned Foods (Rutgers University), Refrigerated Storage of Canned Milk (University of Illinois), Refrigerated Storage of Plants and Nursery Stock (University of Rhode Island), Problems of Water Vapor Movement in Warehouses (Columbia University), Time-Temperature Tolerance of Frozen Foods (U.S.D.A., Albany, Calif.), Stability in Storage and Tenderness of Frozen Poultry (U.S.D.A., Albany, Calif.),* and *Public Health Aspects of Refrigerated Foods (University of Chicago).*

For the record

Proceedings of the First National Electric House Heating Symposium have been issued as a 232-page book, priced at $5.00. Copies may be obtained from the National Electrical Manufacturers Association, 155 East 44th Street, New York, N. Y. Covered are electric heat as such, selection factors, thermostatic controls and discussions of electric heat for apartment houses and schools. This Symposium was held in March of this year; a second is planned for March 1962.

Anniversary noted

ASHRAE's President Walter A. Grant participated in John Cameron Swayze's "Business Final" radio program on the American Broadcasting network on July 18. The occasion was the cited 58th Anniversary of Air Conditioning.

Materials research

Northwestern, Cornell and Pennsylvania Universities are under contract with the Advanced Research Projects Agency to undertake separately a basic research program upon materials which will be conducted in interdisciplinary centers upon a shared cost basis. The Northwestern University contract is for four years and $3,400,000.

Engineering management

There will be a "Managing Tomorrow" conference sponsored by seven major professional engineering societies in Chicago, September 15-16. It is designated as the Eighth Annual Engineering Management Conference; an attendance of 1000 engineers is expected.

Interlaboratory tests

Developed by the National Bureau of Standards, a mathematical model for the statistical analysis of factors involved in the variability of interlaboratory test factors has as its objective the minimization of discrepancies as between similar tests conducted at separate points.

Health environment

At the 88th Annual Meeting of the American Public Health Association, San Francisco, October 31-November 4, there will be exhaustive studies reported upon to an anticipated 5000 attendants. Symposiums are to be held on environmental factors.

OHI celebrates

For the Oil Heat Institute of America, October 9-15, will be a celebration of a program climaxed by National Oil Heat Diamond Jubilee Week marking 75 years of central heating with oil.

Missile environment

As announced by the United States Air Force, there will shortly be three operational Minuteman Squadrons at the Malstrom Base in Montana. These will feature environmental control systems to maintain temperature and humidity in the underground facilities to within close limits to preclude deterioration of electronic equipment. Reliability requirements establish a mean time between failure of 14,000 hr for these systems, defined as the number of total hr running time, without maintenance, for a system or a group of systems divided by the total number of failures occurring during that time.

At the high school level

Financed by a $2,000 grant from the Western Air Conditioning Industries Association, some 40 California High School Juniors or Seniors with outstanding academic records will be invited to a two-day program at the State Polytechnic College. This is cited as being the first major Air Conditioning and Refrigeration career institute for students at the high school level. States Harold P. Hayes of California Polytechnic, "We find numerous young men who have never so much as considered this field of engineering. We see this first institute group as a step toward informing not only the students themselves, but the people back home. One of our most frequent types of engineering opportunities offered to graduates is that of air conditioning engineering."

Nema reports sales

As recorded by the National Electrical Manufacturers Association, sales of room air conditioners (projected) were 1,117,000 units in the first six months of 1960. Similarly projected, electric household refrigerators were 1,777,700 and electric farm and home freezers 574,300.

1960 Cryogenics

Growing, as a project each year, the three-day Cryogenic Engineering Conference held last month in Boulder, Colo., provided 56 invited papers upon its program, divided among the topics of Space Technology, Applications, Superconductivity, Processes, Transfer Phenomena, Equipment, Physical Equilibria, Heat Transfer, and Mechanical Properties.

Try it yourself

Designed around a basic thermoelectric module and consisting of 8 thermocouples fabricated from a new semiconductor material, an experimental kit designed for a study of basic thermoelectric principles has been announced by the General Thermoelectric Corporation of Princeton, N. J. The new semiconductor is a quaternary alloy of bismuth, tellurium, selenium and antimony. It is stated that, heretofore, only binary and ternary alloys have been available commercially.

Peltier refrigeration

Reprinted as a bulletin, "Theoretical Analysis and Performance Characteristics of a Peltier Refrigerator", as presented by Professor E. B. Penrod of the University of Kentucky, was issued originally by the Institut International du Froid, 177 Boulevard Malesherbes, Paris 17, France.

Refrigeration controls

Reflecting both British and American practice, *Refrigeration Controls*, 168 pages, is the third in a series of manuals by the Refrigeration Press Ltd., 131 Great Suffolk Street, London, S.E. 1, England, to offer a practical approach to design and application for refrigeration equipment. Author Harold H. Egginton has concentrated his attention largely upon specific components.

IIR in Marseilles

When the Institut International du Froid, (Commissions III, IV, V) meets in Marseilles, France, September 7-10, there will be several members of ASHRAE on the program. These include; L. H. Leonard (absorption refrigeration), J. R. Chamberlain (lithium bromide in air conditioning) and Edward Simons (multiple jet air curtains).

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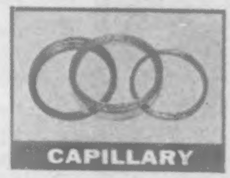

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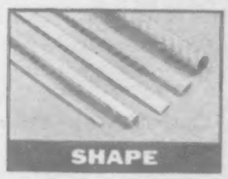

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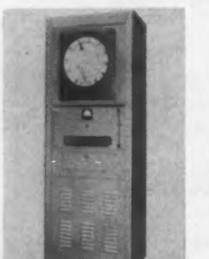
PARTS and PRODUCTS

DEWPOINT RECORDER

Moisture content of a gas is determined by the W-C Dewpoint Recorder by measurement of the dewpoint, the temperature at which vapor first condenses. A photoelectric null system is used to measure the size of the dew spot formed on a metallic mirror by the gas condensate. Size of the dew spot is held in equilibrium by heat applied automatically as needed to the mirror. Temperature of the mirror reads out to the dewpoint of the gas, which in turn describes the moisture content. Readings are independent of test-gas temperature.

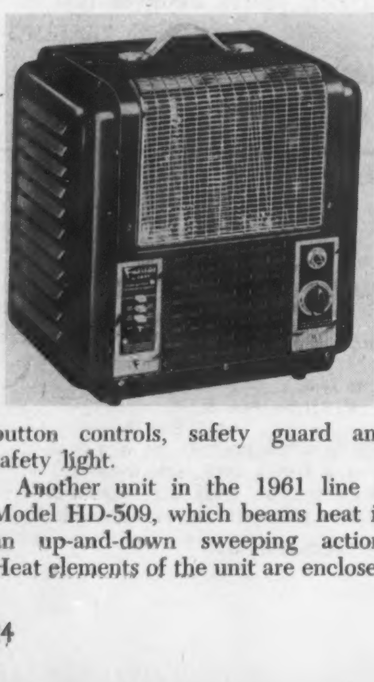


Recorder can be used for such control functions as proportioning, on-off switching and alarm signalling of high or low dewpoint. It is available with choice of standard electric or pneumatic control instruments and with either round or strip chart recording. All components are housed in a single floor-mounted cabinet.

Weighing & Controls, Inc., 948 E. County Line Rd., Hatboro, Pa.

HEATER/AIR PURIFIER

For operation either as an ozone type air purifier or as a radiant fan-forced electric heater, Model HD-506 (shown) features either 1320 or 1650 watt, has an automatic thermostat, push-



button controls, safety guard and safety light.

Another unit in the 1961 line is Model HD-509, which beams heat in an up-and-down sweeping action. Heat elements of the unit are enclosed in heat-resistant tubes placed in front of chrome parabolic reflectors which oscillate when the unit is on. Reflectors may be stopped at any point to remain in a stationary position.

Cory Corporation, 3200 W. Peterson, Chicago 45, Ill.

REPLACEMENT CONTROLS

Basically, A30 Replacements have been simplified to include 23 basic controls and installation packages: six for household refrigeration, four for water and beverage coolers, ten for freezers (with and without signal) and three for air conditioners. Control mounting brackets are designed to adjust to fit most applications and dial shaft extensions are adaptable to any desired length.

Ranco Inc., 601 W. Fifth Ave., Columbus 1, Ohio.

ROOM THERMOSTATS

Featuring a "sealed-in-glass" magnetic switch that provides dust-free operation, series RT includes models for heating only, cooling only or a combination of the two. Thermostats mount flush to the wall and have a temperature dial with wide serrations for easy viewing and setting. Two scales are included, one for temperature setting and another to provide actual readings of room temperature.

Robertshaw-Fulton Controls Company, 911 E. Broad Street, Richmond 19, Va.

GAS HEATER

Burner and pilot on the Profile gas heater operate in a combustion chamber completely sealed away from room air. Factory-assembled vent is inserted through the wall, eliminating chimneys and ductwork. Air for burning is brought through the vent from the outdoors; exhaust products are released directly outdoors.

H. C. Little Burner Company, Inc., San Rafael, Calif.

PRIMARY CONTROL

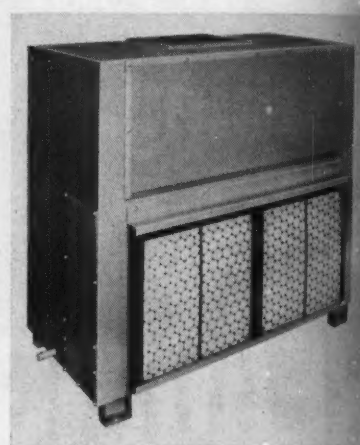
Designated Kwik-Sensor, this burner-mounted primary control for domestic oil burners consists of two parts, a flame detector and a primary unit. Reaction of the former is only to radiant rays from the oil flame, not to heat, permitting mounting at the blower end of the burner. No adjustments or relocation of the flame detector are necessary, even though the burner may be used in different types of furnaces or boilers having various types of combustion chambers. Primary unit may be mounted anywhere, in or on the burner, in the furnace vestibule or in any other convenient location.

Flame detector provides instantaneous response to both flame ignition or extinction, but does not react to the radiant heat of a red-hot combustion chamber or the ignition spark. There is no time lag while awaiting heat build-up or dissipation as with heat-sensing type controls.

White-Rodgers Company, 1209 Cass Ave., St. Louis 6, Mo.

COMPACT AIR HANDLERS

Designed to fit where space is at a premium in apartment houses, office



buildings and commercial establishments, these compact air handling units are offered in horizontal as well as vertical models. Five sizes are available: nominal 800, 1000, 1500, 2000 and 3000 cfm. Cooling coils may be chilled water or direct expansion and heating coils may be hot water or steam.

Thermal Engineering Corporation, P. O. Box 13254, Houston 19, Texas.

LIGHTWEIGHT MOTOR

For operation on dc power sources, Model 4110 features a specially designed flame quench device whereby max cooling air is drawn through the motor while the unit is able to meet explosion-proof requirements. Provision of a smaller and lighter motor is made possible as use of these flame quench rings permits greater heat dissipation and a higher output rating for a given motor frame size.

Several features are: four hp at 8500 rpm continuous duty, six hp at 7300 rpm continuous duty, 26.6

MILESTONE IN MECHANICAL WEATHER

Concerned with the comfort of a rapidly expanding summer audience, New York theatre impressario J. J. Shubert turned to the Worthington Corporation of New Jersey for a master air conditioning system to cool all seven of his famed Shubert Alley Theatres. Worthington engineers solved this intricate mass air conditioning problem by offering a 650-ton central refrigeration plant for installation in an abandoned boiler room beneath historic Shubert Alley. Chilled water is piped from this central plant to cooling units in each of the seven theatres. This unique hook-up serves a combined seating capacity of 7,999 warm-weather patrons, making it the largest single theatrical air conditioning installation ever devised.

SPECIFIED:

Ucon BRAND REFRIGERANT 11

Milestone or mainstay, whatever the unit on your drawing board, one of the five grades of dry, pure, top-quality UCON Brand Refrigerants will charge it to perfection. What's more, through the UCON Brand Refrigerants Technical Assistance program, your UCON Refrigerants Representative offers you expert assistance on matters ranging from technology to refrigeration selection. Put him to work for *you...soon!*

UNION CARBIDE Ucon BRAND refrigerants

These 5 UCON Brand Refrigerants will meet your refrigeration and air conditioning needs

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- UCON Refrigerant 12 Dichlorodifluoromethane
- UCON Refrigerant 22 Monochlorodifluoromethane
- UCON Refrigerant 113 Trichlorotrifluoroethane
- UCON Refrigerant 114 Dichlorotetrafluoroethane

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UNION CARBIDE CHEMICALS COMPANY—*Division of Union Carbide Corporation*

270 Park Avenue, New York 17, New York

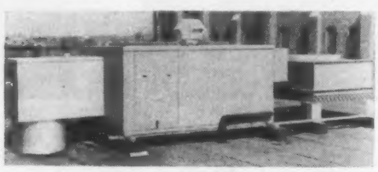
volt dc, reduction gearheads available for lower speeds, replaceable steel insert bearing liners, high temperature winding insulation to 260 F, altitude to 150,000 ft for missile applications and open or totally enclosed construction.
Hoover Electric Company, Hangar Two, Port Columbus, Columbus 19, Ohio.

HEATING, COOLING UNITS

Two low silhouette combination air-cooled air conditioner and gas-fired heater packages for roof mounting are offered with cooling capacities of eight or ten ton and heating capacities of 160,000 or 240,000 Btu/hr output.

Factory assembled, RMU units consist of the heating and cooling system in one package and a separate companion air-cooled condenser. Electricity, gas and coupling of the condenser to the main package are the only field connections required. Filters, blowers, controls, the air conditioning system and the gas-fired heater are housed together. Condenser may be mounted next to the main unit or remotely on the roof. Cooled by a vertical discharge propeller fan, it is unaffected by wind velocity.

Air supply and return are made through the end of the main unit, which may be positioned directly over



the space to be cooled or elsewhere with short duct runs to the distribution point. End connections of the air supply and return eliminate duct connections under the unit and permit easy installation of flashing around the ducts.
Typhoon Air Conditioning Div, Hupp Corporation, 505 Carroll St., Brooklyn 15, N. Y.

THREE-TON COIL

Supplementing the two-ton model previously offered is a nominal three-ton down-flow cooling coil, for add-on application under a down-flow furnace. Unit is provided with a cabinet which supports the furnace operated. Like its predecessor, the coil is insulated extensively to prevent sweating and reduce air noise and is equipped with an expansion valve and condensate eliminator.

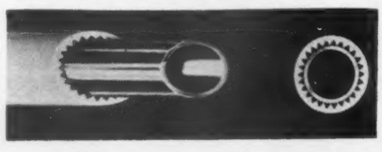
Coil fins have a rippled edge and are flat-bonded to seamless copper tubes for max contact area. Total resistance to air travel is 0.098 iwg at 800 cfm to 0.245 iwg at 1400 cfm.
Lennox Industries, Inc., Marshalltown, Iowa.

ROOF VENTILATORS

Four larger size L-CRF power roof ventilators added to this line range in capacities from 2720 to 27,290 cfm, in hp from ½ to 12 and sound classifications from one to seven. Featured on the units are a new airfoil design, venturi-type inlet, weather-tight housing, direct-connected drive, permanently lubricated motor and low roof silhouette.
Ilg Electric Ventilating Company, 2850 N. Pulaski Rd., Chicago 41, Ill.

INSULATED TUBING

Heat insulated copper tubing, designated ThermoTube, is suitable for continuous use in temperatures to 212 F and is cited as having extreme resistance to cold. A polyvinylchloride jacket is factory extruded over the



tubing with an inner profile of star-shaped serrations. The tips of these serrations rest on the copper tubing, leaving longitudinal air channels which act as insulation. Since the insulation is applied at the factory, on-site labor costs are minimized. Jacket is light in weight, will not support combustion and is cleaned easily.
Columbia Technical Corporation, 61-02 31st Ave., Woodside 77, N. Y.

REFRIGERATORS, FREEZERS

Available in one, two and three-door models, for self-contained or remote installation, these reach-in refrigerators and storage freezers are offered in a choice of either stainless steel or baked-on white enamel exteriors and interiors. Aluminum interiors also are available.

Net capacities of remote installation models are 21.5, 43 and 67.3 cu ft and of self-contained models are 16.75, 38.2 and 62.5 cu ft.
Tyler Refrigeration Corporation, Niles, Mich.

PUMP-MOTOR UNIT

Specifically developed to be run from a 12-volt dc battery, a 0.07 hp series wound dc motor, rated for 2300 rpm, is combined with a pump having a capacity of 25 gph at 60 psi. Designated Series T, the two are connected by a bracket and coupling. Designed for water and similar fluids, the pump is of non-corrosive construction, incorporating a bronze body, stainless steel rotor, carbon vanes and Graphitar bearings.
Tuthill Pump Company, 939 E. 95th St., Chicago, Ill.

ELAPSED TIME INDICATOR

Applicable for time study and cost analysis, periodic maintenance, parts replacement and preventive maintenance, Series 5700 elapsed time indicators can be used in connection with ovens, driers, induction heaters, plastics pre-heaters, generators and similar applications. They have a range

of hr to six digits (minutes available on request) with a min time indication of 1/10 hr. Six display wheels show elapsed time.

Rated at 115 volt, 60 cycle; 230 volt, 50 cycle; 230 volt, 60 cycle; or 240 volt, 60 cycle, these tamper-proof indicators cannot be reset and operate only when the motor is energized. They can be either surface or flush, top or bottom mounted.
Automatic Timing & Controls, Inc., King of Prussia, Penna.

LINE PIERCING VALVE

Designed as a permanent access valve on hermetic units, this Tapzall valve taps all copper tubing sizes from 3/16 through ⅝ in. All-brass construction is satisfactory for use on commonly-used refrigerants.

Valve straddles the tubing and clamps securely when two brass screws are tightened. With a key-type handwheel, there is ample room to install and operate the Tapzall from the top of the valve.
Superior Valve & Fittings Company, 1509 W. Liberty Ave., Pittsburgh 26, Penna.

1961 APPLIANCES

Four advance 1961 appliances, including two single door Dual-Temp refrigerator-freezer combinations and a matching refrigerator and freezer, have been introduced by this manufacturer. Both Dual-Temps are 28 in. wide and feature hidden condensers, so the cabinets can be built-in or placed flush against a wall. Models have capacities of 10.6 and

SIMPLIFY LOW-TEMPERATURE SILVER BRAZING WITH THESE SPECIALLY DEVELOPED FLUXES!

The correct selection of flux can offer unexpected help in speeding and simplifying production, minimizing rejects and lowering costs in low temperature silver brazing operations. The advantages to be gained by "selective fluxing" are *sufficiently important to warrant careful, thorough study!*

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12.7 cu ft, respectively. Featured in the 13.9-cu ft freezer are thin wall construction, door lock and a refrigerated top surface. Matching refrigerator has a capacity of 13.7 cu ft.
Admiral Corporation, 3800 Cortland St., Chicago 47, Ill.

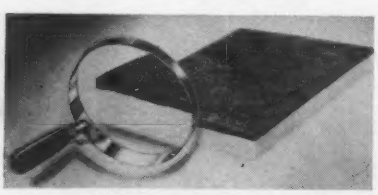
SHAFT ASSEMBLIES

More than 180 variations of flexible shaft assembly have been designed and manufactured by this company. Offered in four different cable sizes (0.130, 0.150, 0.187 and 0.250 in.) as standard flexible shafts for industrial use and as panel-mounted flexible shafts with the mounting nuts as part of the shaft itself, these assemblies are available with mono-directional cable for motor driven or high speed applications and bi-directional cable for hand-operated control applications.
F. W. Stewart Corporation, 4311-13 N. Ravenswood Ave., Chicago 13, Ill.

GLASS FIBER DUCT LINER

In ½, 1, 1½ and 2-in. thicknesses, this new liner is a resilient, semi-rigid insulation blanket of strong, fine glass fibers bonded by a thermo-setting resin. It is made up of two different densities of insulation.

Black-colored surface is made of heavy density fiber for resistance to high air velocities of up to 5000 fpm encountered in contemporary duct systems. Its toughness is cited as making it easy to form integral nos-



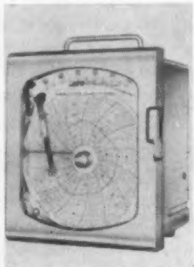
ings at the leading edges when the material is being installed in ducts, eliminating metal holding strips and metal nosings. Underneath this heavy density surface is a light density portion, amber in color, which provides better sound absorption and overall thermal performance. Noise reduction coefficient of the ½-in. material is 0.60. Fire hazard rating is low and the material is light in weight.
Johns-Manville, 22 E. 40th St., New York 16, N. Y.

OIL FURNACE

Installed flush with the wall, Duo-Therm Model 335 oil furnace is cited as providing more floor space and an unbroken expanse of wall, making it suitable for compact residences. It may also be installed against the wall or in any corner. Capacity of the unit is 60,000 Btu.
Motor Wheel Corporation, Lansing 3, Mich.

COMFORT INDEX RECORDER

Self-contained and portable, this instrument measures temperature and humidity and records the combined measurements as the Temperature-Humidity Index. Measuring elements are mounted in the case, and the chart is spring-driven.



Two models are offered: the Comfort Index Temperature Recorder, which indicates comfort index and records both this and the ambient temperature, and the Comfort Index Recorder, which indicates and records comfort index only. Records are on a six-in. diam, seven-day rotation chart.
Bristol Company, Waterbury 20, Conn.

MANIFOLD VALVE

Compact and leakproof, the P-727 series contains three valves in one unit and is designed for use with differential-type measuring, recording or transmitting instruments. Constructed of brass and 303 stainless steel, with operating pressures from zero to 2000 psi, it is suitable for use in systems containing air, alcohol, ammonia, argon, hydrocarbons, natural gas and numerous other fluids. The unit does not require valve seat replacements or operating adjustments. Valve position is shown by toggle-type handle position, and the "T" handle of the balancing valve is color-coded for identification.
Circle Seal Products Company, Inc., 2181 Foothill Blvd., Pasadena, Calif.

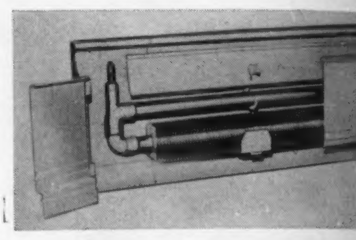
SUB-ZERO CHILLER

Model SU2-80-4 is a dual chambered low temperature chilling machine designed for installation in testing or processing lines where operators are located on both sides of the line. Each operator has access to a separate and individually controlled chamber, permitting simultaneous processing of two different products.

Both chambers have individual cascade refrigeration systems with adjustable temperature ranges from ambient to −100 F and thermal capacities of 500 Btu/hr at −100 F. Refrigeration tubes completely surround the chambers to assure even temperature distribution. In addition, individual fin coil and blower assemblies provide circulation at all times. Chambers measure 12 x 24 x 17 in. and are galvanized to prevent corrosion. Each has two adjustable shelves, full opening doors and a 1½-in. access port.
Cincinnati Sub Zero Products, 3932 Reading Rd., Cincinnati 29, Ohio.

BASEBOARD RADIATOR

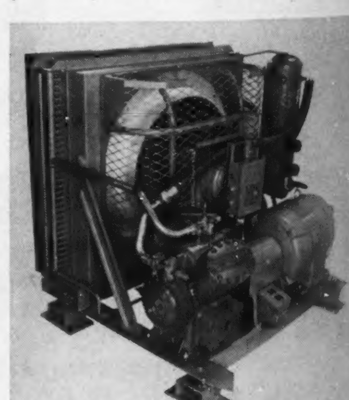
Rated at 600 Btu per linear ft using water at 180 F, this baseboard radiator features finger-tip control damper



and units that snap together, with standard fittings used throughout. Brackets that are die-made and designed to grip the element securely, as well as providing a place on which the tubing can rest, are cited as providing noise-free expansion.
A. Brown Products Corporation, Union, N. J.

RAILROAD CAR UNIT

Developed for use in railroad cars, this high-capacity mechanical refrigeration assembly has easy-to-service features. Separate motor and compressor permit quick replacement of either of these parts with little loss in availability of the car. Installation and servicing are facilitated further by easily-disconnected, self-sealing



couplings which eliminate the need to dehydrate the system before it is put back in operation.

Designed to operate between −10 and 70 F, the compressor is driven by a 15-hp electric motor. A cen-

MOTORS LET YOU USE ALL THE HORSEPOWER YOU PAY FOR...SAFELY

The man and the motors from Westinghouse now provide absolute protection against motor failure caused by excessive heat . . .

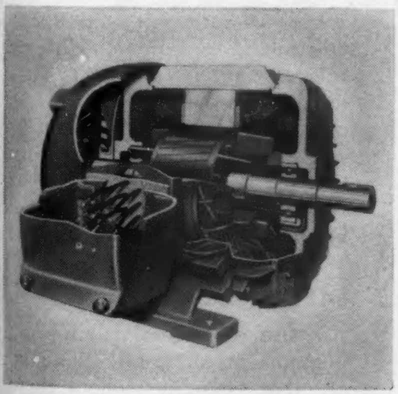
Our Engineering Manager says:
"With the breakthrough development of the Westinghouse Positive Temperature Coefficient thermistors, for the first time we can provide inherent protection against motor failure caused by excessive heat. The solid-state thermistors buried in the windings instantly sense excessive heat from any cause and simultaneously warn of trouble or automatically take the motor off the line. Thus, motor protection is placed where only true motor protection can be . . . in the windings."

Our Marketing Manager says:
- "You can match the motor to the load . . . use all the motor you are paying for.
- Provides positive protection based on winding temperature . . . *not* load current and/or power supply fluctuations.
- Eliminates time and expense of changing winter-summer heaters. No nuisance tripping, it's fail-safe . . ."

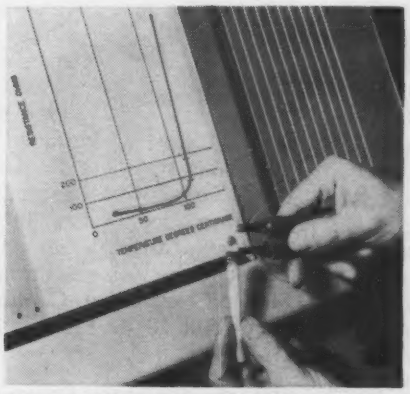
Call your Mr. Westinghouse for the application of a Guardistor* motor to your drive requirements . . . write for *Questions and Answers About . . . Guardistor* (B-7876). Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. You can be sure . . . if it's Westinghouse.

*Trade-Mark

J-22160-R



Unlike remotely located sensing devices, PTC thermistors are buried in the windings of the Guardistor motor, instantly equating all temperature factors.



Ever alert PTC thermistors constantly totalize temperature, statically triggering an action *only* if critical temperature is reached.

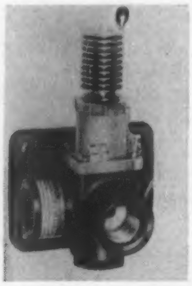
MOTOR & GEARING DEPARTMENT

Westinghouse

trifugal fan with backward curved blades guards against overloading the evaporator fan motor.
Carrier Corporation, Syracuse 1, N.Y.

CONTROL VALVE

For use in airborne heat exchangers, Model 1975 is operated by varying temperature, which opens or closes a valve poppet to permit the flow of a coolant liquid such as anhydrous ammonia. Valve is available in both on-off and modulating types.



In use, the power element projects into the outlet of the heat exchanger. Increasing air temperature in the outlet duct opens the valve poppet, permitting the coolant to flow into the coils. The non-electric control eliminates a source of radio noise interference.

Designed to operate at 90 F (±2 F), and adjustable between 80 and 100 F, the valve can handle inlet pressures between 20 and 550 psia with no external leakage and max internal leakage of 0.5 cc/hr. Max flow is 0.2 lb/min at 500 psi inlet pressure. Power elements are available for actuation temperatures ranging from 30 to 220 F. Nonoperating temperature range extends from −65 to 160 F.
Robertshaw-Fulton Controls Company, 911 E. Broad Street, Richmond 19, Va.

RANGE HOOD

Featured on 5700 Series Range Hoods are an extra-large permanent aluminum foil filter, twin centrifugal force blowers, two-speed operation and twin frosted lens light fixtures to provide even, glare-free illumination.

Hood is easily adapted for vertical or horizontal exhaust by re-positioning the blowers. Blowers have an air moving capacity of 400 cfm and are especially effective where small ducts or long runs are required in the exhaust system.
Leigh Building Products Div, Air Control Products, Inc., Coopersville, Mich.

PRODUCT COOLERS

Flexibility in mounting is provided in three capacity sizes of 58,000, 75,000 and 92,000 Btu/hr at 10 F T.D. for this new series of refrigeration product coolers, Models PCV and PCH. Each size is offered in vertical or horizontal mountings. Discharge nozzles with double deflection louvres are available as accessories.

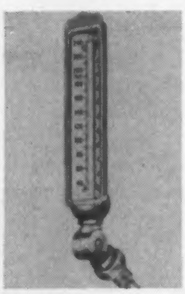
Series is designed to provide dependable protection where above freezing temperatures must be kept within critical limits. Features include plate-type aluminum fins with full collar, expanded copper tubes, sealed ball-type fan bearings and motor mounted inside unit on adjustable base.
Bohn Aluminum & Brass Corporation, Danville Div, Danville, Ill.

WEATHERSTRIP

Made of flexible aluminum combined with a durable vinyl bulb, Nu-Koil comes packed in an individual 17-ft roll complete with nails, instructions and a nailing guide. Aluminum cap is notched to allow flexibility around corners in doors and windows and the bulb is designed to make an air-tight seal.
Macklanburg-Duncan Company, Box 1197, Oklahoma City 1, Okla.

INDUSTRIAL THERMOMETERS

Cited as eliminating selection problems for varying pipe line and air duct requirements, these thermometers can be angle-adjusted on the job to meet piping layout changes. Stem tilts or rotates to any angle for easy reading without parallax error. Capillary is totally enclosed and protected within an adjustable fitting.



Thermometers are available with standard separable sockets for pipelines, extension neck sockets for insulated lines and adjustable stems for air duct installations. Series includes seven, nine and twelve-in. scale sizes in corrosion-resistant, cast V-shape metal cases with double-thick glass fronts.
Moeller Instrument Company, Richmond Hill 18, N. Y.

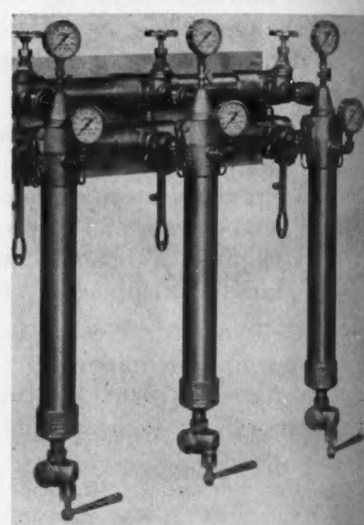
HEATER BANK ASSEMBLY

For air conditioning ducts, Model 2-PO-AD, an oven-type plate heater bank assembly, provides high capacity, low watt density heat exchange with fast heat-up and min restriction to air flow. Assembly consists of flat plate heaters mounted in tandem and can be made in varying heights, lengths and widths for installation in any size air duct. All heater surfaces are plated sheet steel and are electrically insulated. Heater plate thicknesses are 3/16 in.; distance between plates is determined by heating requirements. Banks can be connected for single or three-phase, 208, 220 or 440 volt.
Electric Heater Specialty Company, 21 E. 8th St., New York 3, N. Y.

WALL MOUNTED FILTERS

Used for prevention of nozzle plugging, elimination of iron oxide and pipe scale, clarification of viscous liquids, protection of hydraulic valves and flow-meters and other critical filtering applications, this line of quick-coupling fluid filters has been designed for wall mounting to free floor space. They are made for water, oils or chemicals, hot or cold.

Elements will withstand 150 psi differential pressures without collapse.



Filters are rated 5 to 350 gpm, 10 to 700 mesh, pressures to 200 psi and temperatures to 450 F. They are made two, three (shown) or four in parallel and are available in bronze, steel, 316 stainless steel, monel and aluminum.
Ronningen-Petter Company, Vicksburg, Mich.

SAFETY DOOR SWITCH

For use on access doors leading to plenums in air conditioning systems or other chambers where there is a possibility of hazard to service personnel, this safety switch, Model S911, allows for flexibility of location and position on either left or right hand door openings and has contacts rated at 15 amp, 125 volt ac.

Safety features provide for manual unscrewing of a wing nut before the access door can be opened. This operation interrupts the primary power from the generator, preventing a re-

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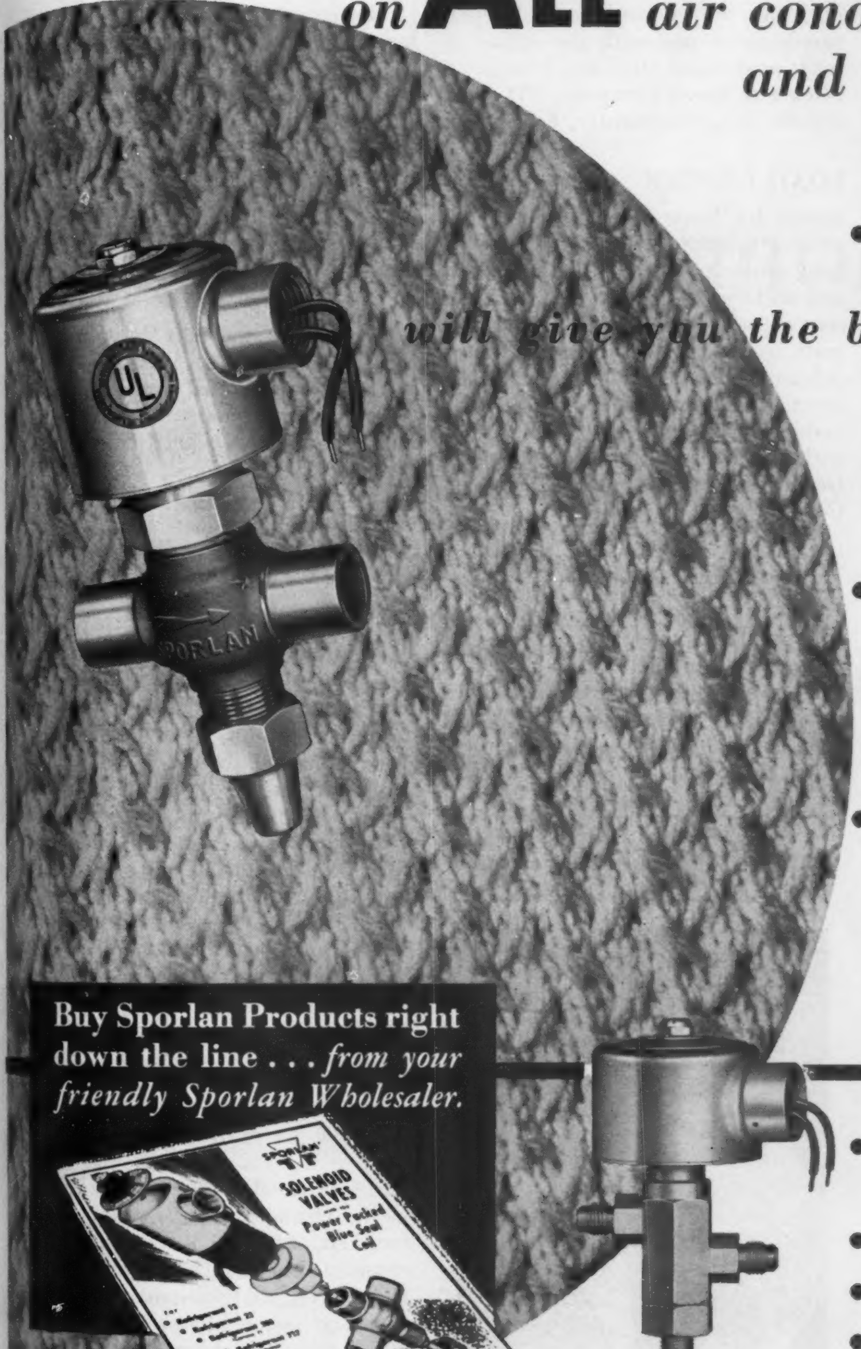

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sumption of power should the door close after a man has entered the chamber. A second feature is that the switch cannot be locked on with the access door open, requiring a second man at the switch if high voltage equipment is to be checked.
CRS Industries, Inc., 1405 Locust St., Philadelphia 2, Pa.

AIR-COOLED CONDENSERS

Now available from this manufacturer is a complete range or air-cooled condensers, from eight to 85 ton, in single units for air conditioning and refrigeration applications. Thirteen sizes of horizontal and vertical flow Aircon are available with almost un-

limited capacity in multiple unit installations.

Seasontrols, automatic head pressure controls, are available as accessories, and modulate condenser capacity in accordance with the weather.
McQuay, Inc., 1600 Broadway St. N.E., Minneapolis 13, Minn.

SELF-PRIMING PUMPS

Discharging up to 7000 gph, these compact, lightweight, high capacity self-priming utility pumps can be lifted and transported easily by one man. Non-clogging impeller handles water with a high percentage of solids and has a quickly removable suction plate for ease of inspection and cleaning of the unit.

Two sizes are available: M-5 (5000 gph with 1½-ft suction) and M-7 (7000 gph with two-ft suction).
F. E. Myers & Bro. Company, Ashland, Ohio.

FLOWMETER

Miniature in size, the Minirator has been designed specifically for measurement of low flow rates of either liquids or gases. Standard parts for varying capacities are interchangeable. Tube is of the snap-in type, permitting a change in range in a few sec. Floating between the end fittings on o-ring seals, the tube is free from pipe line vibrations and misalignment stresses. End fittings can be rotated through a full 360 deg for ease in mounting, and the meter is designed so that it may be surface or flush mounted on a panel or installed in line. Unit is available with 1½ or 4-in. scales, with or without an integral needle valve and with the option of brass or stainless steel end fittings.
Fischer & Porter Company, 551 Jacksonville Rd., Warminster, Pa.

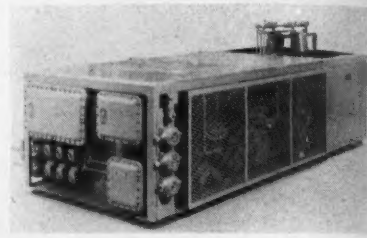
LOAD CENTER

Suited for home electric heat applications, this 200-amp split bus "Twin" load center is available in both flush and surface design. It has space for six two-pole breakers in the 200-amp main section, three of which serve as sub-section mains, and accommodates up to 28 single-pole circuits with one-in. TQL breakers or 30 circuits with 2-in-1 "Twin" breakers.
General Electric Company, Plainville, Conn.

THREE-CHAMBERED UNIT

Designed to offer increased versatility in production processing and research testing, by simultaneously providing three separate low temperature liquid refrigerating baths operating at the same or different constant temperatures, this unit is of liquid-tight, heliarc welded 14-gauge stainless steel construction. Two chambers measure 14 x 20 x 24 in. and can be set independently to operate at any temperature from −70 to −150 F; the third measures 34 x 20 x 24 in. and will operate at temperatures from −70 to −170 F.

Refrigerating coils are mounted adjacent to the chamber walls with-



in the baths for max heat transfer efficiency. Each bath is equipped also with a ¼-hp vertical agitator to provide uniform temperatures throughout the fluid. Net capacity of the dual cascade water-cooled refrigeration system is approximately 5000 Btu/hr at −150 F.
Cincinnati Sub Zero Products, 3930 Reading Rd., Cincinnati 29, Ohio.

ASHRAE Public Relations Has Cansdale Assist

James H. Cansdale has joined the New York headquarters of ASHRAE as Assistant Secretary—Public Relations and Fund Raising. Prior to this association with ASHRAE, he was director of Public Relations for the International Division of the General Electric Company. He is a graduate of Columbia University.

INDUSTRIAL HEATER

Designed to be used as central furnace, unit heaters with directional discharge nozzles, or as duct furnaces with allowance for future addition of air conditioning, the dual-fuel OG4 series can be installed for up-flow, down-flow or horizontal delivery. Both No. 2 fuel oil and gas may be burned in a single burner assembly with fuel selection determined by a manual selector switch.

Heat exchanger of the line provides for unrestrained expansion and contraction even at an abnormal temperature rise of 180 F. Oil burner is of the mechanical atomizing type with ignition provided by direct spark with low-fire start. Suction-type two-stage pump has twin solenoid valves for positive shut-off. Gas burner is of the inshot type for natural, manufactured, and LP-air mixtures. Included in the manifold are motorized main valve, pilot solenoid, manual gas cock and line regulator.

Self-contained blower section may be furnished bolted to heat exchanger assembly or separate. It consists of a slide-rail-mounted ball bearing motor with adjustable drives powering two forward curve full-width blowers.

Unit is adaptable to all voltages, control circuit is 115 volt. Capacity in Btu/hr input for Model OG4-940 is 940,000 and for Model OG4-1250 is 1,250,000.
Lennox Industries, Inc., Marshalltown, Iowa.

ASHRAE JOURNAL
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SEPTEMBER 1960

Weather does affect mortality

Added to all of the other reasons why air conditioning is significant, are the related facts presented here, which suggest that air conditioning while increasing man's overall comfort level also is bringing about a gradual trend toward a lessening of the weather-mortality response.

In this study of weather's effect on the mortality rate, some pertinent considerations are discussed whereby improving man's environmental climate, his life span may be increased. The author also points out refrigeration's contribution in this aspect.

P. H. KUTSCHENREUTER

Heating, ventilating and air conditioning are all concerned with altering the artificial environmental climate to achieve an increase in man's general comfort level and efficiency. Numerous studies have been directed toward determining the optimum environmental climate for various types of activity. For the most part these deal with comfort and health levels, concepts which are highly subjective and which vary with individuals. One may reason that climatic factors which increase the discomfort and contribute toward poor health would, at least in the extreme, also increase the death rate. Mortality rate then, might be used as a more objective index for a study of climatic factors detrimental to comfort and health.

The study which is reported here was not undertaken specifically with the aims and objectives of heating, ventilating and air conditioning engineers in mind. Some of the results, however, particularly with reference to extreme summertime conditions, have been found to be of considerable interest to many.

Two rather important climatic factors have been recognized as triggers for disease. These are abrupt weather changes and prolonged warm or cold spells. The first results in a strain on the body and its nervous system; the latter in exhaustion. Presumably these same factors should contribute toward increased mortality.

The climate of the northeastern United States, not duplicated elsewhere in the world, provides an ideal testing ground for both of these adverse climatic factors. This area is on, or close to, every major storm track of the North American continent. The climate of the area undergoes a monsoonal change from the domination of cold, dry polar air in winter to warm, moist tropical air in summer. There are frequent clashes between these two air masses of quite different physical properties and the area is exposed to the often violent storms which accompany such clashes, as well as prolonged periods of extremely cold or hot weather due to stagnation under the regime of one or the other of these extremes in air mass.

The Bureau of Records and Statistics, Department of Health, which maintains mortality tabulations for the City of New York, began in June of 1949 to prepare these tabulations on the basis of actual date of occurrence in each of several age groups. The population included in these statistics is that of the five boroughs which comprise the City of New York. This, then, provides an opportunity to compare weather with mortality in a climate best suited to yield results under such a comparison.

P. H. Kutschenreuter is Assistant Chief of the U. S. Weather Bureau. This is a condensation of a paper presented as "Weather and Mortality" at a meeting of the Washington Chapter, Amrican Society of Heating, Refrigerating and Air Conditioning Engineers, February 1960.

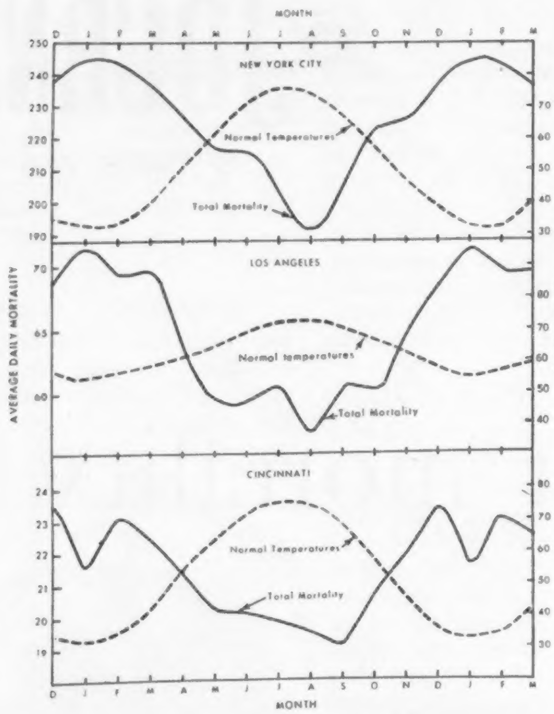


Fig. 1 Annual mortality curves for New York City, Los Angeles and Cincinnati

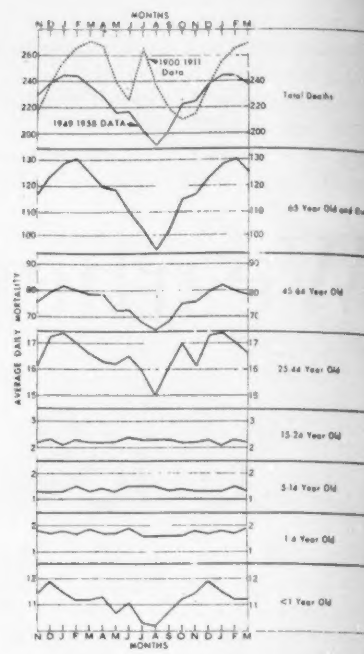


Fig. 2 Annual mortality curves for all age groups for New York City. (Solid lines are 1949-58 data. Dotted line is 1900-1911 data)

For possible seasonal influences of weather on mortality, the annual mortality curves of three large cities in the United States will first be examined. Fig. 1 shows the annual mortality curves for New York City, Los Angeles and Cincinnati, together with the annual normal temperature curves for the same cities. The same general mortality trends are noted in all three instances: highest mortality during the winter, lowest mortality during the summer. The trend, as might be expected, appears more pronounced in the case of both Cincinnati and New York City where the annual temperature range also is much greater than that of Los Angeles.

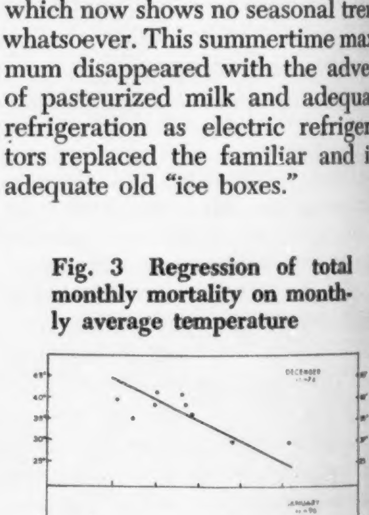
Fig. 2 shows the annual mortality curves for the 9½-year period (June 1949-December 1958) for New York City for each of seven age groups as well as for total mortality, which is shown in the top panel. Two facts are immediately apparent. There is no seasonal trend whatsoever in the age groups from one to twenty-four. Also, the same general seasonal trend of low summertime mortality and high wintertime mortality is apparent for all age groups twenty-five and older as well as for the infant group.

An examination of New York City birthrate statistics for this same period shows no significant seasonal variations that would permit one to consider this seasonal trend in infant mortality the result of a corresponding seasonal fluctuation in the size of the infant population. This apparent response to seasonal climatic change among infants appears, instead, to be an indirect climatic effect due to colds and other infectious ailments which are passed along to the infant by its parents and others. This accounts for the disappearance of the seasonal trends after infancy. From these curves it is evident that man's tolerance to climatic changes decreases with increasing age once he reaches age 25.

One particularly significant fact is apparent in the top panel of Fig. 2 where the dotted line indicates mortality averages for the years 1900 to 1911 based on an article by Huntington in 1917. These earlier data indicate a pronounced secondary mortality maximum in July, a maximum which in current data has been replaced by a pronounced minimum.

Further examination of available statistics for the period 1900-1911 indicates that this secondary maximum in total mortality was primarily the result of a mortality maximum which occurred in the 1-4 year group in July, a group which now shows no seasonal trend whatsoever. This summertime maximum disappeared with the advent of pasteurized milk and adequate refrigeration as electric refrigerators replaced the familiar and inadequate old "ice boxes."

Fig. 3 Regression of total monthly mortality on monthly average temperature



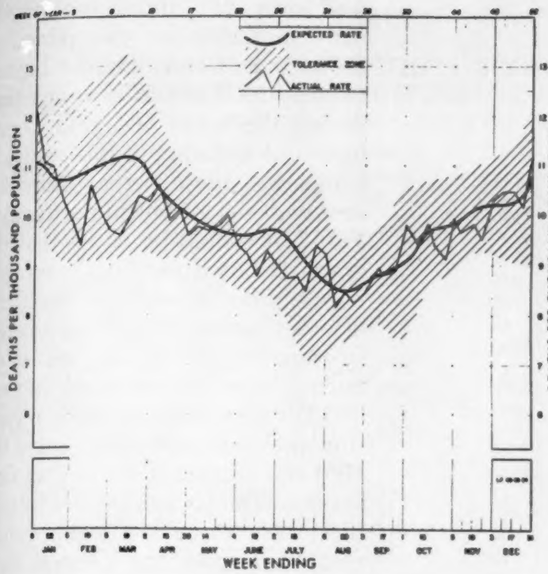


Fig. 4 New York City mortality chart for 1954

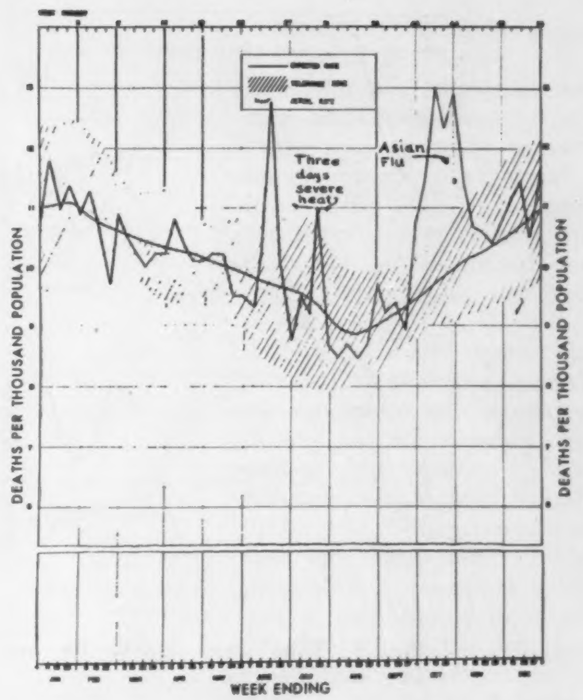


Fig. 5 New York City mortality chart for 1957

This is an important indication of the manner in which advances in one branch of technology contribute materially to the results in another.

It is probable that the current efforts of the heating, ventilating and air conditioning engineers in increasing man's overall comfort level are also bringing about a gradual trend toward a lessening of the weather-mortality response. Any such trend, however, could only be established with the availability of a considerable amount of additional statistical data, data of a type not readily available without a comprehensive and well-designed data gathering program specifically designed for this purpose.

From numerous studies on "comfort" temperatures it is reasonable to expect that extremes in seasonal and monthly temperatures would be reflected in perhaps proportionate departures from normal mortality. This expectation is borne out in the scatter diagrams and regression curves for total mortality shown in Fig. 3. Each dot represents data for one month (excluding influenza months) that were used in developing the regression equations for the curves shown. The correlation coefficients for the two winter months of December and January are –0.74 and –0.96 respectively. Both correlations are significant at better than the 2% level. For the two summer months, June and July, the correlation coefficients are 0.67, both significant at the 5% level.

The correlations for the spring and fall months were insignificant and meaningless, as is to be expected since the correlation swings twice through zero each year, ranging from significant negative wintertime values to significant positive summertime values.

Examining shorter period mortality fluctuations, Figs. 4 and 5 show graphs of the actual and expected New York City mortalities as maintained on a weekly basis by the New York City Bureau of Records and Statistics. The "expected rate" is the weekly average for the previous five years smoothed over a five-week period. The "tolerance zone" indicates the 2σ (2 standard deviations) limits either side of the computed average. The "actual rate" shows the actual weekly mortality (based on date of reporting, however, rather than on date of occurrence). These graphs provide a weekly running check of the general state of health of the population of the City of New York.

Fig. 4 indicates that there were no periods of excessive mortality at any time during the year 1954: all weekly mortality values were well within the 2σ tolerance zone. Similarly, the 1954 weather in New York City was predominantly "normal" with no periods of marked departures. Fig. 5, however, shows three distinct periods of excessive mortality in 1957, the first two ascribed to excessive heat and the last to Asian influenza.

For the purpose of this study the following five criteria have been established as defining a hot spell:

1. Three or more consecutive days with three-day mean departure from normal temperature ≥ 5 F.
2. At least one day with a departure from normal temperature ≥ 10 F.
3. The three-day mean departure from normal temperature remains positive throughout the period.
4. The maximum temperature exceeds 90 F on at least one day.
5. The hot spell begins on the first day the three-day mean departure from normal temperature is ≥ 5 degrees and ends on the first day the three-day mean departure is ≤ 5 degrees and remains less than 5 F.

Using these criteria it was established that during hot spells there existed a definite phase rela-

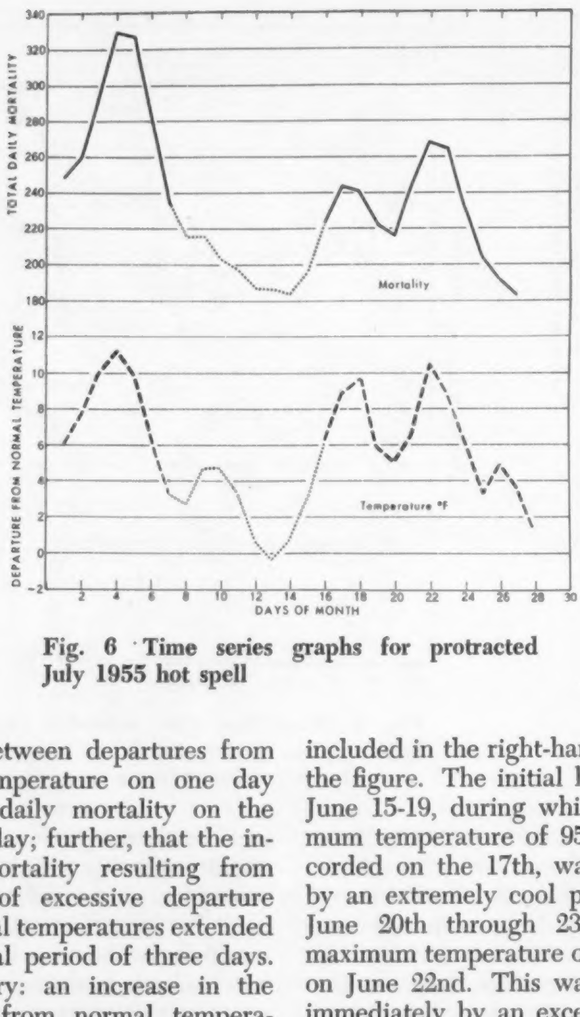


Fig. 6 Time series graphs for protracted July 1955 hot spell

tionship between departures from normal temperature on one day and total daily mortality on the following day; further, that the increased mortality resulting from a period of excessive departure from normal temperatures extended over a total period of three days. In summary: an increase in the departure from normal temperature on one day during a hot spell is accompanied by an increase in the mortality rate for that day, a much greater increase on the following day and a diminishing rate of increase on the third day.

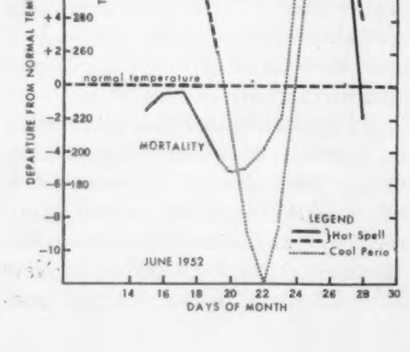
All comparisons of summertime temperatures with total daily mortality as used in this study were therefore based on three-day averages, with the mortality for one day correlated with the maximum temperature at the U. S. Weather Bureau station in Central Park on the preceding day.

The in-phase relationship is evident in Fig. 6. The period shown in this figure covers two hot spells within the month of July 1955, the latter of which covered a period of 12 successive days. The same relationship was evident for all hot spells during the ten summers included in this study.

Fig. 7 shows the temperature-mortality comparison for a particularly catastrophic hot spell during June of 1952. Daily temperature data from the U. S. Weather Bureau station in Central Park are included in the right-hand panel of the figure. The initial hot spell of June 15-19, during which a maximum temperature of 95 F was recorded on the 17th, was followed by an extremely cool period from June 20th through 23rd with a maximum temperature of only 62 F on June 22nd. This was followed immediately by an excessively hot period from June 24th to June 27th, with a maximum temperature of 100 F on the 26th.

As a result of these excessive and rapid temperature fluctuations the total daily mortality figure for June 27th reached 528, which is well over 2½ times the normal daily mortality for this period of the year and is by far the highest one-day total recorded at any time during the entire 9½-year period of record included in this study. In comparing these actual daily figures with the graphical portrayal in Fig. 7, it should be noted that the graph is based on 3-day averages.

Fig. 7 A catastrophic June hot spell



In order to evaluate the effects of other meteorological parameters by months during all hot spells during these ten summers (a total of 133 days) linear multiple regression analyses were made, using the IBM 650 computer at Rutgers University. The six independent variables were three-day mean values computed from the Central Park weather observations of:

1. Departure from normal temperature (ΔNT)
2. Maximum temperature (Tx)
3. Average hourly wind velocity (wind)
4. Temperature-Humidity Index at 1:30 p.m. (THI)
5. Relative Humidity at 1:30 p.m. (Rh)
6. Barometer reading (station pressure at 7:30 a.m.) (PPP)

Table I shows the correlation coefficients between total mortality and the six independent variables, together with the critical significance values for all hot spells during each of the four months (June, July, August and September) during which hot spells occurred. It is obvious that temperature (either ΔNT or Tx) is the most important

Fig. 7(a) Daily temperature data

JUNE

DATE	Tx	Tn	T̄	ΔNT	WIND
15	93	68	81	+10	SW 7.8
16	85	69	77	+7	SE 6.0
17	95	70	83	+11	SW 8.4
18	88	70	79	+7	W 10.2
19	87	66	77	+5	SW 10.7
20	78	59	69	−3	NW 8.8
21	64	59	62	−11	NE 8.0
22	62	58	60	−13	NE 9.4
23	64	58	61	−12	E 7.7
24	85	62	74	+1	SW 7.0
25	99	75	87	+14	S 8.6
26	100	81	91	+17	W 7.7
27	90	72	81	+7	N 7.9

Tx MAXIMUM TEMPERATURE
Tn MINIMUM TEMPERATURE
T̄ MEAN TEMPERATURE
ΔNT DEPARTURE FROM NORMAL TEMPERATURE
WIND PREVAILING DIRECTION AND AVERAGE HOURLY VELOCITY

TABLE I

CORRELATION COEFFICIENTS BETWEEN TOTAL MORTALITY AND INDEPENDENT VARIABLE

(9½ years record — June 1, 1949 to Dec. 31, 1958)

Month	N	Critical Significance Values	Independent Variable	Total Mortality
			ΔNT	.858
June	43	5% = .297	Tx	.693
Hot		2% = .350	Wind	.579
Spells		1% = .385	THI	—.221
		0.1% = .480	PPP	.220
			Rh	.316
			ΔNT	.737
July	45	5% = .290	Tx	.749
Hot		2% = .342	Wind	—.306
Spells		1% = .376	THI	—.380
		0.1% = .470	PPP	.003
			Rh	.357
			ΔNT	.887
August	37	5% = .321	Tx	.850
Hot		2% = .376	Wind	—.173
Spells		1% = .413	THI	.728
		0.1% = .513	PPP	.058
			Rh	—.753
			ΔNT	.983
September	8	5% = .666	Tx	.989
Hot		2% = .750	Wind	—.752
Spells		1% = .798	THI	.931
		0.1% = .898	PPP	.725
			Rh	—.827

N = Number of observations
ΔNT = 3-day mean departure from normal temperature
Tx = 3-day mean maximum temperature
Wind = 3-day mean 24-hour average hourly wind velocity
THI = 3-day mean noon temperature-humidity-index
PPP = 3-day mean 7:30-a.m. barometer reading (station pressure)
Rh = 3-day-mean noon relative humidity

meteorological parameter for high total mortality. This was true also for mortality in each of the separate age groups as well as for both the white and non-white segments of the population. It is equally obvious that PPP is the least significant of the meteorological parameters.

In order to rank the other parameters, a simple scoring system was devised, weighting them in relation to the order in which each appeared in the regression analyses, the order being determined on the basis of greatest reduction in residual error. In accordance with this scoring system the ranks were as follows: ΔNT – THI – Tx – Rh – Wind – PPP. Except for September, which comprised only a single hot spell of 8 days duration, PPP (atmospheric pressure) was not significant at any chosen level.

CONCLUSIONS

The more complete study of Reference 2 includes numerous factors which have not been treated here. From the data included herein, however, two important facts stand out: first, refrigeration has already contributed greatly in lowering the mortality rate by largely eliminating one important indirect effect of weather on mortality; second, by improving man's environmental climate, his life span may be increased.

From this standpoint there are six important considerations:

1. Man's tolerance to climatic changes decreases with increasing age, once he passes the age of 25.
2. There is a significant correlation between monthly mortality and monthly average temperatures, with mortality increasing during winter months with temperatures appreciably below normal and also during notably hot summer months.
3. Superimposed upon the seasonal summertime mortality minimum are significant maxima during periods of extremely hot weather. These summertime hot spell mortality maxima are so pronounced that the daily totals during periods of extreme hot spells may actually exceed by a factor of 2 or more the daily figures which would be expected even during the much higher mortality period of the coldest winter months.
4. Rapid summertime temperature fluctuations ranging from well above normal to well below normal result in significant mortality increases.
5. The highest single daily mortality during the 9½-year period included in this study occurred during an extreme hot spell; the figure of 528 for one day during that period exceeded by far the highest single daily figures recorded even at the height of the Asian influenza period.
6. The most significant meteorological factor in connection with high summertime mortality is high temperature. Humidity (and, similarly, THI) and wind are also significant.

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2. Kutschenreuter, Paul H., "A Study of the Effect of Weather on Mortality in New York City", Thesis, Graduate School, Rutgers University, January 1960.

ASHRAE
NATIONAL MEETINGS AHEAD

1961	1962	1963
Feb. 13-16 Semiannual Chicago, Ill.	Jan.28-Feb. 1 Semiannual St. Louis, Mo.	Feb. 11-14 Semiannual New York, N. Y.
June 26-28 Annual Denver, Colo.	June 25-27 Annual Miami, Fla.	

How to use slat-type between-glass shading devices to

Reduce solar heat gains

N. OZISIK

L. F. SCHUTRUM
Member ASHRAE

Increased use of and widespread interest in those slat-type sun screens positioned between two sheets of glass as a means of controlling solar heat gains led to this research program which was conducted at the ASHRAE Research Laboratory in Cleveland, Ohio. The research has had the benefit of the guidance of the former RAC on Energy Transfer through Fenestration* and has been a continuation of the general study on solar heat gains through windows. Considerable data have been published for slat-type shades located either inside or outside of single glass, and the excellent analysis given in Ref. 1* has been drawn upon extensively for this study of shades positioned between two sheets of glass.

EXPERIMENTAL EQUIPMENT

Shading devices tested consisted of commercial sun screens positioned between two sheets of common window glass (Normal Transmittance about 0.87) in the following manner: (1) the sun screen in direct contact with both sheets of glass; (2) in direct contact with both sheets of glass and having the sun screens embedded in plastics; (3) with a small space between the sun screen and the two glasses. These three shading devices were commercially available. A fourth type consisting of venetian blind slats between two sheets of glass was constructed at the Laboratory. A description of the shades tested is given in Table I.

The shading devices were tested under natural weather conditions by means of the Solar Calorimeter which was first put into use in 1947. The calorimeter can be rotated to any desired orientation and tilted to any position from horizontal to vertical. The test window opening was 44¼ x 44¼ in., and was essentially flush with the outer surface of the 8-ft sq surrounding well.

The heat gained by the calorimeter was absorbed by a temperature-controlled mixture of ethylene glycol and water which was circulated through tubes soldered to the inside surface of the calorimeter. Solar radiation measurements were made with Eppley pyrheliometers mounted symmetrically on the wall. One pyrheliometer was positioned 12 in. above and the other 12 in. below the window. A 16-point recorder provided continuous readings throughout the test.

TEST PROCEDURE

All tests were made with the window glass in a vertical position and with the calorimeter continuously adjusted to follow the sun or with a fixed orientation. During the 10 or 15-min test intervals, records were kept of the altitude of the sun, the wall solar azimuth, wind velocity and direction, and the condition of the sky, as well as temperature and solar radiation measurements.

The total heat gain of the calorimeter was determined by computation from the quantity and temperature rise of the circulating fluid and was adjusted for the small heat flow through the back of the apparatus. This total heat gain is the sum of the solar radiation transmitted through the window and the convection-radiation gain from the warm glass.

The convection-radiation gain was determined from previously established calibration curves based on the temperature of the inner glass and the temperature of the heat absorbing surface of the calorimeter. The transmitted solar

"Instantaneous heat gains through slat-type between-glass shading devices have been predicted with engineering accuracy from the incident solar radiation, the outdoor air temperature, and the K and U values reported here. The use of these shading devices result in a reduction of instantaneous heat gains which would be about 35 to 60 per cent of the gain through a window of regular plate glass."

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1. ASHVE Research Report 1460, The Shading of Sunlit Glass—An Analysis of the Effect of Uniformly Spaced Flat Opaque Slats by G. W. Parmelee and W. W. Aubele (ASHVE Transactions, Vol. 58, 1952, p. 377)

N. Ozisik was formerly Research Engineer and L. F. Schutrum is a Research Supervisor, ASHRAE Research Laboratory. This paper, here somewhat condensed, was presented as "Solar Heat Gains Through Slat-Type Between-Glass Shading Devices" at the 67th ASHRAE Annual Meeting, Vancouver, B. C., June 13-15, 1960.

TABLE 1 DESCRIPTION OF SLAT-TYPE SUNSHADES

Type	Color or Appearance	Solar[a] Absorptance α	Slats Per Inch	Slat Spacing Inches	Slat Width In.	Slat Thickness In.	Slat Angle Degrees	Degrees Cut Off Angle[d] Air	Plastics[e]
A) Kaiser	Aluminum	0.37[b]	17½	0.057	0.057	0.0085	17	32	52
B) Reflectal	Black	0.8	23	0.043	0.047	0.0051	17	29	47
C) Reflectal	Black	0.8	17	0.059	0.047	0.0075	17	42	83
Venetian Blinds	Dark Green	0.7[c]	0.6	1.67	2.0	——	45	10	—

a Values of 0.37 and 0.8 taken from Ref. 2
b The room side of some of the screens tested were painted black. 0.8 was assumed fog absorptance
c Measured with pyrheliometer, compared with magnesium carbonate
d Minimum profile angle at which none of the sun's rays pass between the slats.
e Computed for index of refraction of 1.49

energy was then determined by subtracting the convection-radiation gain from the total calorimeter gain.

ANALYSIS

Part of the solar radiation falling on a sun screen is transmitted through, another portion is reflected back, and the remainder is absorbed by the screen.

With the screen positioned between two sheets of glass, the sun's rays must first pass through the outer glass, then the sun shade, and finally the inner glass before entering the room. The incident solar radiation reflected from the outer glass passes to the exterior of the building and is no longer considered. Of the remaining radiation, part is absorbed and warms the glass, and a portion is transmitted through to the sun shade. The sun shade, in turn, either reflects, absorbs, or transmits this solar energy. Part of the energy reflected from the sun shade passes through the outer glass to the exterior, part is absorbed by the glass, and the remainder is re-reflected to the sun shade. The solar energy that is absorbed by the sun shade will increase its temperature. The radiation passing through the sun screen falls on the inner glass and again the phenomenon of reflection, absorption and transmission occurs.

Now, recall that the total heat gain measured by the solar calorimeter consisted of transmitted solar energy and a convection-radiation component.

The convection-radiation component is the result of the warm glass radiating to the room surfaces and convecting to the room air. The temperature of this inside glass is dependent upon the solar energy absorbed by it, and upon the heat exchange with the sun shade and with the room. Similarly, the temperature of the sun shade depends upon the absorbed solar energy and the heat exchange with both inner and outer glasses. The temperature of the outer glass results from the balance of absorbed solar energy and heat exchange with the sun shade and with the outdoors. These heat exchanges between the glasses and shade occur by various combinations of convection, conduction and radiation, depending upon the construction of the between-glass shading device.

The purpose of the theoretical analysis was to be able to extend the data beyond the confinements of the experiments, but first the theory had to be confirmed by comparison with experimental data. The calculated total heat gains as obtained by the methods referred to above can be compared with the total heat gains measured by means of the solar calorimeter under natural weather conditions.

DESIGN FACTORS

The instantaneous heat gain is given by the following equation:

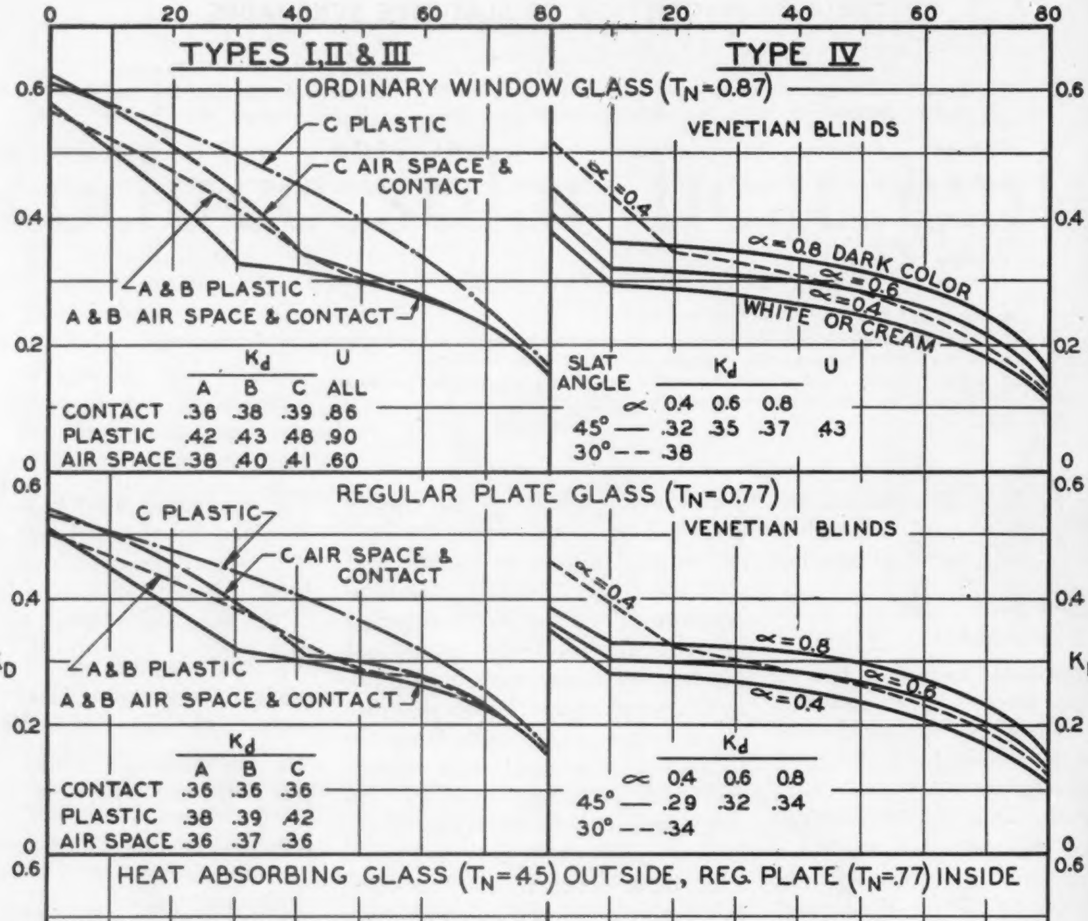
$$Q = K_D I_D + K_d I_d + U (t_o - t_i) \qquad \text{Eq. 1}$$

K_D and K_d are dimensionless solar heat transfer factors for direct and diffuse solar radiation respectively; they depend upon the type of fenestration as well as the angular relation between the window and the sun. I_D and I_d are the intensity of the direct and diffuse solar radiation falling upon the glass surface. U is the conventional

TABLE II DIRECT AND DIFFUSE SOLAR RADIATION INCIDENT UPON VERTICAL WALLS, WALL SOLAR PROFILE ANGLES, AND OUTDOOR AIR TEMPERATURES, (40° N. LAT., AUGUST 1, CLEAR ATMOSPHERE, FROM GUIDE)

Sun Time	Outdoor Air Temp,F,t_o	I_{ND}[a]	North ϕ[b]	North I_D[c]	North I_d[d]	East ϕ	East I_D	East I_d	South ϕ	South I_D	South I_d	West ϕ	West I_D	West I_d
AM														
6	74	133	40.1	32	12	11.8	126	22			9			8
7	75	210	78.4	17	16	23.2	193	34			14			12
8	77	246			17	34.6	203	36	82.8	17	19			16
9	80	266			19	46.6	179	35	74.8	52	23			18
10	83	279			20	60.0	133	30	70.8	81	26			19
11	87	286			21	74.7	70	26	68.7	101	28			22
12	90	288			22			23	68.0	108	29			23
PM														
1	93	286			21			22	68.7	101	28	74.7	70	26
2	94	279			20			19	70.8	81	26	60.0	133	30
3	95	266			19			18	74.8	52	23	46.6	179	35
4	94	246			17			16	82.8	17	19	34.6	203	36
5	93	210	78.4	17	16			12			14	23.2	193	34
6	91	133	40.1	32	12			8			9	11.8	126	22

a Direct normal solar radiation Btu/hr/sq ft
b Wall solar profile angle, degrees
c Direct incident solar radiation in plane of wall, Btu/hr/sq ft
d Diffuse incident solar radiation in plane of wall, Btu/hr/sq ft



	K_d A	K_d B	K_d C	U ALL
CONTACT	.36	.38	.39	.86
PLASTIC	.42	.43	.48	.90
AIR SPACE	.38	.40	.41	.60

SLAT ANGLE	K_d ∝ 0.4	0.6	0.8	U
45° —	.32	.35	.37	.43
30° - -	.38			

	K_d A	B	C
CONTACT	.36	.36	.36
PLASTIC	.38	.39	.42
AIR SPACE	.36	.37	.36

	K_d ∝ 0.4	0.6	0.8
45° —	.29	.32	.34
30° - -	.34		

	K_d A	B	C
CONTACT	.37	.36	.35
PLASTIC	.36	.36	.38
AIR SPACE	.33	.32	.33

	K_d ∝ 0.4	0.6	0.8
45° —	.26	.27	.28
30° - -	.28		

Fig. 1 K and U values for between-glass slat-type sunshade devices (For description of A, B, C type shades—see Table I)

overall heat transfer coefficient and t_o and t_i are the outside and inside air temperatures respectively.

The K_D, K_d and U values for various slat-type between-glass shading devices are given in Fig. 1. Note that the value of K_D depends upon the profile angle which is defined in Fig. 2. The U-values were calculated by combining an inside overall coefficient of 1.5 Btu/hr/ft²/F and an outside coefficient of 3.0, with the thermal conductance of each window.

The thermal conductances were measured in the calorimeter under night-time conditions and/or in a special set-up used to measure the conductances of one-foot square samples. The intensities of direct and diffuse solar radiation, outdoor air temperatures and profile angles taken from the GUIDE are given in Table II for 40° N. Lat., August 1.

Example of Heat Gain Calculation —A West-facing window on August 1, 40° N. Lat., at 2 p.m., according to Table II, has a profile angle of 60 deg with the sun, a direct solar radiation of 133 Btu/hr/sq ft and a diffuse radiation of 30 Btu/hr/sq ft falling on the glass, and an outdoor air temperature of 94 F. Suppose the window is composed of a contact or type I shading device of ordinary window glass and with a type C sun shade. From Fig. 1, K_D is 0.27 at a profile angle of 60 deg, K_d is 0.39 and U is 0.86. The heat gain is 64 Btu/hr/sq ft.

No shading of the window by set-back or overhang is assumed. If external shading existed the direct radiation term would necessarily have to be reduced by the ratio of unshaded area to the total area of the glass.

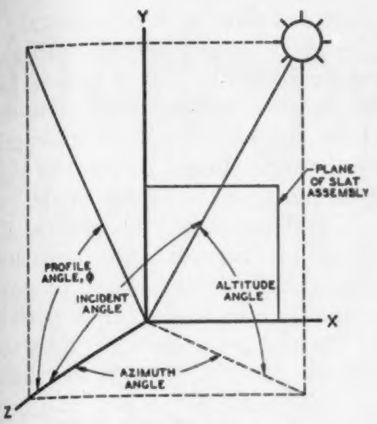


Fig. 2 Definition of angles

By way of comparison, Table III gives the heat gains for East, South, and West oriented windows for various between-glass sun shades used in combination with ordinary window glass, and for single ordinary window glass alone. These heat gains are based on the solar radiation and outdoor air temperatures listed in Table II and, except for the single glass, were calculated by means of Equation 1 and Fig. 1.

Transmitted Component—The magnitude of the transmitted solar energy is an indication of the amount of light or visible energy entering the room through the window. The calculated transmittances of these fenestrations are given in Fig. 3. The effect of the plastics material is to shift the angle at which the direct beam of solar radiation is cut off to higher profile angles, thus increasing the transmittance.

In general, the darker colored slats (α large) and the greater slat angles show lower transmittances.

GLASS SURFACE TEMPERATURES

The comfort of the occupants may be influenced by the surface temperature of the inner glass if the glass area is large or the persons are near the window. The total convection and radiation gain from the window, excluding transmitted solar radiation, is the result of the inner glass radiating to other room surfaces and convecting heat to the room air. The glass temperature can be found if the room temperature (t_o), the combined inside convection and the radiation coefficient (h_o), and the convection and radiation heat gain into the room are known.

The above example giving the method for heat gain calculation resulted in a total gain of 64 Btu/hr/sq ft. The transmitted energy is the sum of the products of the direct and diffuse solar intensities given in the example, and the direct and diffuse transmittances given in Fig. 3. This amounts to about 8.5 Btu/hr/sq ft for the example. Then the convection-radiation gain is 64-8.5 or 55.5 Btu/hr/sq ft.

The temperature difference between the inner glass and the room is equal to the convection-radiation gain divided by the combined inside coefficient $\frac{55.5}{1.5}$ (value used in Fig. 3) = 37 F, and the inner glass temperature becomes 37 + 75 = 112 F.

The inside glass temperatures which can be expected for a West oriented window at 4 p.m. under the conditions given in Table II would be from about 108 F to 131 F for ordinary window glass, with the lower temperatures corresponding approximately to the sun screen having the lower solar absorptances. The temperature of inner and outer glasses would be nearly the same.

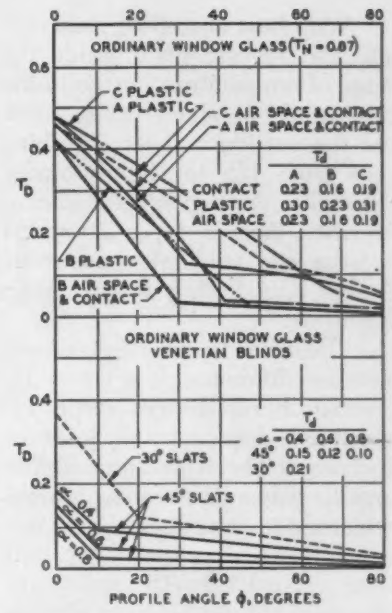


Fig 3 Transmittance of between-glass slat-type sunshade devices

Note: For Regular plate glass multiply T_D by 0.75. For Heat absorbing—Regular plate multiply T_D by 0.4 for direct and T_d by 0.45 for diffuse radiation.

TABLE III HEAT GAIN FOR SLAT-TYPE BETWEEN-GLASS SHADING DEVICES AND FOR ORDINARY WINDOW GLASS, BTU/(HR) (SQ FT) (AUGUST 1, 40° N LAT., CLEAR ATMOSPHERE, INDOOR TEMP. 75 F)

Orientation & Sun Time	SLAT-TYPE BETWEEN-GLASS SHADING DEVICE WITH ORDINARY WINDOW GLASS: Air Space & Contact[a] A & B	C	Plastics A & B[a]	C	45° White Venetian Blinds	Single Ordinary Window Glass
EAST						
6 AM	69	78	73	82	43	128
7	89	108	102	118	66	199
8	81	97	95	116	68	211
9	71	76	75	96	59	187
10	53	54	56	66	42	137
11	33	33	36	39	25	71
12 Noon	20	20	23	25	14	33
SOUTH						
8 AM	11	11	12	13	9	20
9	23	23	25	27	18	48
10	34	35	37	40	26	78
11	43	44	47	52	33	104
12 Noon	48	48	52	57	37	115
1 PM	48	48	52	57	36	110
2	42	43	47	50	31	90
3	34	34	38	40	25	63
4	23	23	27	29	16	37
WEST						
12 Noon	20	20	23	24	14	33
1 PM	37	38	42	44	27	77
2	61	62	66	76	47	147
3	82	87	89	109	65	204
4	93	109	110	131	76	228
5	102	121	118	134	74	217
6	82	90	88	97	51	144

[a] Average K & U values used for computation because of small differences.

With heat absorbing glass outside and regular plate inside the range of temperature for the inside glass would be about 112 to 130 F and the outside or heat absorbing glass from 125 to slightly under 150 F. For the higher thermal conductance devices types II and I (plastics and contact), the outside glass is only slightly warmer than the inside.

The inside to outside glass temperature difference is greatest for venetian blind devices (type IV) which have comparatively low conductances. This temperature difference increases as the solar adsorptance of the slats decreases.

RESULTS

All of the test data were taken with both glasses approximately equivalent to common window glass; however, it is believed that calculated K values are also reasonably accurate for the regular plate (Normal transmittance 0.77) and heat absorbing glasses (Normal transmittance 0.45). No adjustment was made for the selective transmittances of two sheets of glass which is relatively more important for higher absorbing glasses.

The solar properties of the sun screens depend upon the profile angle which was defined in Fig. 2, but the solar properties of the glass are dependent upon the incident angle. Thus both profile and incident angles should be used to determine the thermal performance of a between-glass shading device; however, for the sake of simplicity, it was decided to accept the error involved and neglect the effect of change with incident angle.

Consequently, the transmittance of the outer glass was taken at an incident angle equal to the profile angle and a small error would then occur for only those angles of incidence much greater than the profile angle. The calculated values which are slightly higher on the average than the experimental data, were based on the profile angle for the transmittance of the glass.

A correction for the true incidence angle would bring some of the calculated points closer to the experimental values. Also the storage of heat in the glass and shade has been neglected in presenting

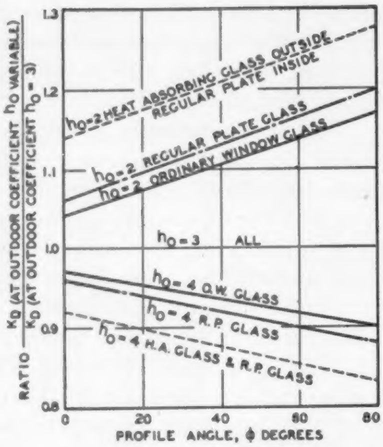


Fig. 4 Approximate effect of combined outdoor coefficient of heat transfer h_o, on the K_D factor for between-glass shading devices

the K factor. The magnitude of the storage, determined in the solar calorimeter, was less than 10% of the total gain.

The K and U values given in Fig. 1 were based on an overall outside coefficient of 3 Btu/hr/sq ft/F between the outer glass and the outdoor air. Calorimeter data indicate outdoor coefficients lower than 3 on an average. The outdoor coefficient does not influence the transmitted component of heat transfer but only the convection and radiation gains. Thus in Fig. 4, which shows the trend of the K_D value with the outdoor coefficient, a greater change is shown for the higher profile angles where the convection and radiation component of the total solar gains is proportionately larger.

The slat-type shading devices (horizontal slats) have greater transmittances for radiation from below the horizon and, consequently, the amount of solar radiation reflected from the foreground will influence the diffuse transmitted component (included in K_d). For this diffuse component it was assumed that 75 per cent of the diffuse or sky radiation came uniformly from above the horizontal, and 25 per cent from below.

Venetian blinds with the slats mounted vertically were also tested in the solar calorimeter with a fixed slat angle of 45 deg. The conductance of the device was about the same with the venetian blind slats either vertical or horizontal. The predicted solar heat gains based on K and U values agreed with the measured total gain. However, for blinds with vertical slats set to exclude the sun, the wall solar azimuth angle should be used in Fig. 1, in place of the profile angle.

Difference in the diffuse K_d terms for vertical and horizontal slats should be secondary in magnitude as long as the bright portion of the sky (near the sun) does not radiate directly through the shade because of slat angle, and extremely bright foregrounds are avoided.

NOMENCLATURE

- A — Solar absorptance of an element when in combination with other elements of the fenestration, dimensionless
- C — Conductance of shading device (outside surface to inside surface) Btu/(hr) (sq ft) (F)
- CR — Combined convection and radiation exchange, Btu/(hr) (sq ft)
- G — Thermal resistance from an element of the fenestration to inside (F) (hr) (sq ft) per Btu
- h — Thermal conductance Btu/(hr) (sq ft) (F)
- I_D — Intensity of direct solar radiation on a vertical wall, Btu/(hr) (sq ft)
- I_d — Intensity of diffuse solar radiation on a vertical wall, Btu/(hr) (sq ft)
- K — Solar heat transfer factor, dimensionless
- Q — Total heat gain into room per unit area of the window, Btu/ (hr) (sq ft)
- q — Transmitted solar energy Btu/ (hr) (sq ft)
- R — Radiation exchange Btu/(hr) (sq ft)
- ρ — Reflectance for solar radiation, dimensionless
- T — Solar Transmittance, dimensionless
- t — Temperature, Fahrenheit degree
- U — Over-all coefficient of heat transfer, Btu/(hr) (sq ft) (F)
- α — Solar absorptance, dimensionless
- αI — Solar energy absorbed by the glass or shade Btu/(hr) (sq ft)
- ϕ — Wall solar profile angle, degrees

Subscripts

- $_{1, 2, 3}$ — Refer to indoor glass, shade screen, and outdoor glass respectively
- $_{32, 321}$ — For solar radiation, refers to the combined property
- $_{31, 32, 21, \text{etc.}}$ — For convection, radiation and thermal conductance, refers to exchange between elements
- $_c$ — Convection
- $_{cr}$ — Convection and radiation
- $_D$ — Direct solar radiation
- $_d$ — Diffuse solar radiation
- $_N$ — Normal incidence
- $_r$ — Radiation
- $_{i, o}$ — Inside and outside

Draft performance of chimneys

W. G. BROWN

C. WACHMANN

Recently published information on the draft performance of domestic chimneys,[1,2,3] although obtained for specific chimney shapes and sizes, has been useful in estimating performance for many actual conditions. Occasionally, however, information is required which does not fall within the limits covered by these test records, for example in chimneys of unusual shape or size, and some suitable design procedure is required.

In this connection, many solely mathematical approaches to the prediction of chimney performance have been made[4] and are still being made[5] without the benefit of experimental comparison. More recently, Schmitt and Engdahl[3] have shown indirectly that these mathematical calculations compare quite poorly with experiment. They proposed an empirical design method for masonry chimneys 10 to 25 ft in height and with cross-sectional areas of 35 to 55 sq in., which has been included in the ASHAE Guide. This design method has been criticized for accuracy, because some other records[1] disagreed considerably for chimney heights slightly greater than 25 ft.

The effect of wind on chimney draft performance has not been studied in detail in actual chimney installations although Schmitt and Engdahl have made a laboratory study which showed wind could either improve or retard the ability of a chimney to exhaust its gases, depending on the direction of the wind. Model studies by Wannenburg and Van Straaten[6] to determine the pressures over the walls and roofs of buildings indicated that the performance of a chimney in wind would probably depend on the shape and orientation of the building.

Calm conditions, under which the available performance records have been obtained, are not frequent. In Ottawa, Canada, for example, calm periods occur on a yearly basis only 1 to 2 per cent of the time and wind speeds of 6 to 8 mph occur during 30 per cent of the year.[7] Although these wind effects are likely to be of considerable importance in some chimney installations, there is every indication that they can be treated separately from the performance under conditions of no wind.[6,8] Hence before attempting to analyze these effects the steady no-wind performance should be established as completely as possible.

In a previous paper[8] the general theory of steady-state chimney performance was developed and appeared to compare well with the experimental records for one of the fourteen chimneys tested by Achenbach and Cole.[2] Friction losses for the chimney were determined by isothermal tests on a model, the assumption being that the losses were essentially the same for non-isothermal flow of the chimney gases. To study further the usefulness of the design method indicated by the theory, tests were suggested to determine the friction losses for other shapes and sizes of chimneys. This work has now been extended and results of both model friction-loss tests and draft tests on a masonry chimney are reported in this paper.

THEORY

As reported previously,[8] the draft available in a chimney could be de-

Draft, efficiency, and friction loss records obtained with masonry chimneys of three different heights were compared with previous records and with calculations based on model tests. The non-isothermal friction losses were found to be far greater than isothermal losses due to natural convection effects. The effect of low wind speeds over the chimney top was also found to be considerable. Similar wind effects were found in model tests and this indicates that wind effects for chimneys can be treated separately from steady-state performance and studied using models.

W. G. Brown is a Research Officer, and C. Wachmann a former Research Officer, Div of Building Research, National Research Council, Canada. This paper, here slightly condensed, is a contribution of the Div of Building Research of the National Research Council of Canada and is published with the approval of the Director of the Division; it was presented at the ASHRAE Semiannual Meeting in Dallas, Texas, February 1-4, 1960.

termined with reasonable accuracy from the equations*:

$$\frac{D}{\Delta\rho_T\, gH} = Y\left(1 - K \cdot \frac{\rho_m}{\Delta \rho_m} \cdot \frac{V_m^2}{2gH}\right) \quad (1)$$

$$Y = \frac{\Delta \rho_m}{\Delta \rho_T} = \left(\frac{T_m - T_o}{T_1 - T_o}\right) \cdot \frac{T_1}{T_m} \quad (2)$$

and

$$T_m = \frac{T_1 + \left(\frac{F}{R}\right)\left(\frac{H\, T_R}{C_p W}\right)}{1 + \left(\frac{F}{R}\right)\left(\frac{H}{C_p W}\right)} \quad (3)$$

where:

D = chimney draft (ambient air pressure minus pressure at chimney inlet)
$\Delta\rho_T$ = difference in density between ambient air and chimney gas at the chimney inlet
g = acceleration due to gravity
H = chimney height above chimney inlet
$\Delta\rho_m$ = mean difference in density between ambient air and chimney gas within the chimney
ρ_m = mean chimney gas density
V_m = mean chimney gas velocity
T_m = temp corresponding to the mean chimney gas density (absolute)
T_o = ambient air temp (absolute)
T_1 = chimney inlet temp (absolute)
T_R = room air temp (absolute) for inside chimneys (equal to T_o for outside chimneys)
F = a constant depending only on the geometry of the chimney
R = thermal resistance of the chimney walls
C_p = specific heat of the chimney gases
W = mass flow rate of the chimney gases
K = the chimney friction factor (for isothermal flow at least, dependent only on the Reynolds number $\frac{V_m d}{\nu_m}$ where d is a characteristic chimney size parameter, usually diam, and ν_m is the kinematic viscosity).

* These equations are given in slightly different form from that used previously.

Equation (1) is the basic equation for chimney draft relating chimney efficiency, $\frac{D}{\Delta\rho_T gH}$, to friction pressure loss, $K\rho_m\frac{V_m^2}{2}$ and to heat exchange through the chimney walls as manifest in the term Y. Equation (3), giving the temperature T_m corresponding to the mean chimney gas density is derived by eliminating the chimney exit temperature T_2 from the two following equations:

$$T_m = T_1 - F(T_1 - T_2) \quad (4)$$

and

$$W\, C_p(T_1 - T_2) = \frac{H}{R}(T_m - T_R) \quad (5)$$

Equations (4) and (5) presume that the temperature drop occurring throughout the chimney is approximately linear and that the temperature corresponding to the mean density of the chimney gases is the same as the mean temperature. Equation (5) equates the heat loss by the chimney gases to the heat flow across the chimney walls.

EQUIPMENT AND TEST PROCEDURE

NRC masonry chimney – The test chimney (to be referred to as the NRC chimney), (Fig. 1), was constructed of standard clay brick with a vitrified clay liner firmly grouted into place. Flue dimensions were 7 x 7 in. The chimney thimble, a 7-in. inside diam steel tube, entered the chimney at right angles 3.3 ft above the floor. Overall chimney height above the thimble centerline was 24.0 ft, of which 38 in. extended above the top of the containing building. Draft probes were installed in the connecting duct 1.2 ft from the inside face of the chimney liner and at flue center-line 6.0, 16.3, and 22.7 ft above the thimble center-line. During tests differential drafts between the thimble and various points along the vertical chimney were measured by connecting the draft probes to a micromanometer. Bare chromel-alumel thermocouples were installed at connecting duct center-line, at the position of the draft probe and at flue center-line at heights above thimble of 2.3, 6.0, 11.0, 16.3 and 22.7 ft. In addition, an aspirating thermocouple was used to check thermocouple readings.

Flue gas for the tests was supplied by a propane furnace. An egg-crate type air straightener fitted in the connecting duct between the furnace and chimney ensured uniform temperature and velocity at the chimney inlet. Combustion air was supplied by a blower. Air flow

Fig. 1 Layout of the NRC test chimney

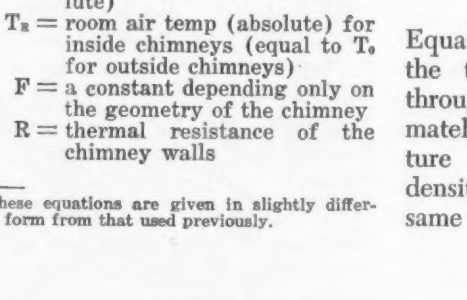
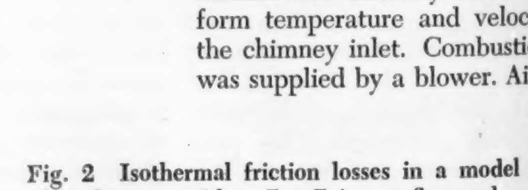


Fig. 2 Isothermal friction losses in a model of a chimney with a 7 x 7 in. sq flue and a 7 in. diam thimble



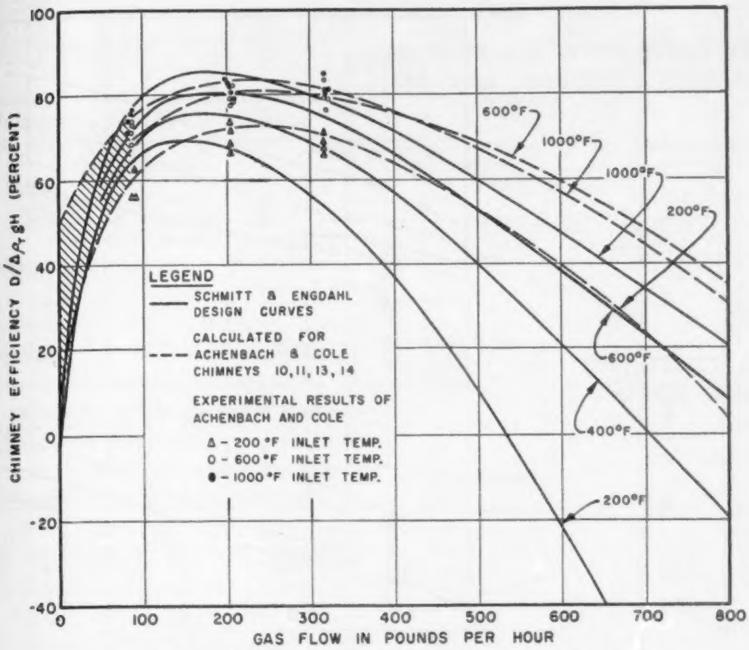


Fig. 3 Comparison of ASHAE design curves (Schmitt and Engdahl) with data of Achenbach and Cole and calculated performance

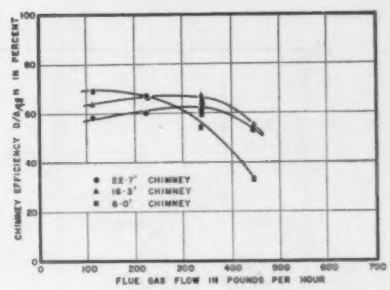
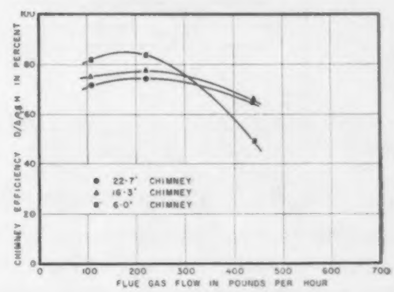


Fig. 4 Efficiencies of the NRC test chimney. (Inlet temp 350 F)

Fig. 5 Efficiencies of the NRC test chimney. (Inlet temp 750 F)



to the furnace was measured with calibrated orifices and propane gas flow was measured with a wet-test meter.

Models—Several models of conventional chimney shapes, including that of the NRC chimney, were constructed of round and rectangular tubing about 1/5 to 1/7 scale. Friction-loss tests on these models were conducted using the method previously outlined.[8]

Scope of tests—The NRC masonry chimney was tested at flue gas flow rates of 25, 50, 75 and 100 cfm, (standard air, 70 F and 29.92 in Hg), and at chimney inlet temperatures of 350 F and 750 F. All tests were made in summer and early fall, so room temperature T_R was essentially the same as the outside air temperature T_O.

The model chimneys were tested at room temperature at various flow rates corresponding to the range of Reynolds numbers observed in full-size chimneys.

RESULTS AND OBSERVATIONS

Isothermal friction tests with models—Results of tests to determine the friction factor on a model of the NRC masonry chimney (Fig. 2) showed the manner in which K varied with Reynolds number for isothermal flow. (Both $K = \dfrac{-2D}{\rho_m V_m^2}$ and $Re = \dfrac{V_m d}{\nu}$ were computed on the basis of the mean chimney thimble velocity and thimble diam.) Results obtained with the other models were similar although values differed depending on the geometry. Results were also similar to those observed previously[8] for models with round chimneys and thimbles of the same size.

Before considering the test results for the NRC masonry chimney, previous test records shall be compared with calculated performance based on the theory and using the model results for the friction factor K.

Results of tests by Achenbach and Cole[2] on four masonry chimneys of cinder concrete 15½ ft high and having geometry similar to that of the NRC chimney have been plotted in Fig. 3 as $\dfrac{D}{\Delta\rho_T gH}$ against flow rate as suggested by Schmitt and Engdahl.[3] The recommended design curves of the latter authors are included for comparison. The experimental results agree moderately well with the design curves in the range of flow rates tested, but there is an indication that at high rates (above 300 lb/hr) agreement will be increasingly poor. This is especially noticeable at a gas temperature of 200 F. Similarly, the shape of the design curves appears to be considerably different from that of the experimental curves.

With the assumption that friction losses in non-isothermal flow remain essentially the same as in isothermal flow it is now possible to use Equations (1) to (3) to calculate the performance of the brick chimneys. The factors F and R (both assumed constant) in Equation (3) are difficult to calculate accurately, however, hence the actual experimental temperature data for the four chimneys were used to determine average values.

Using Equation (3) and the mean flue gas temperature as given by Achenbach and Cole, the mean value of F/R was found to be 1.2 Btu/hr/F/ft. (It was necessary to assume T_R = 70 F for these calculations since indoor air temperature was not given.) Using this average value of F/R and Equation (3), the

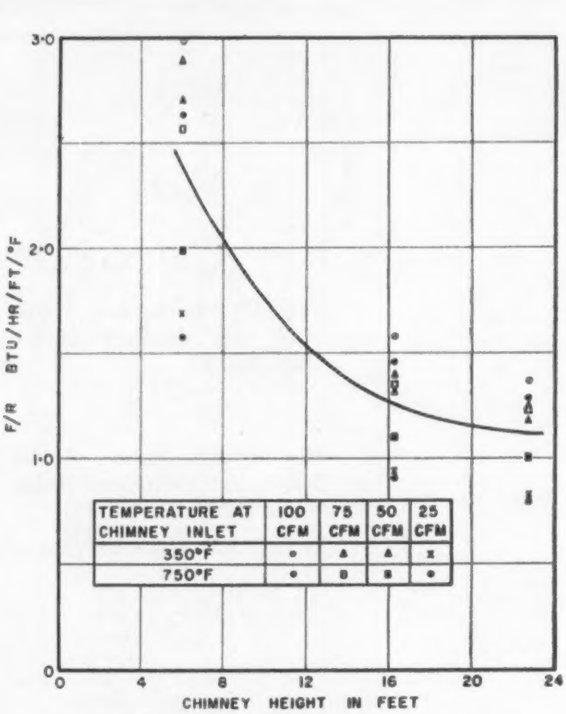


Fig. 6 F/R values for the NRC test chimney

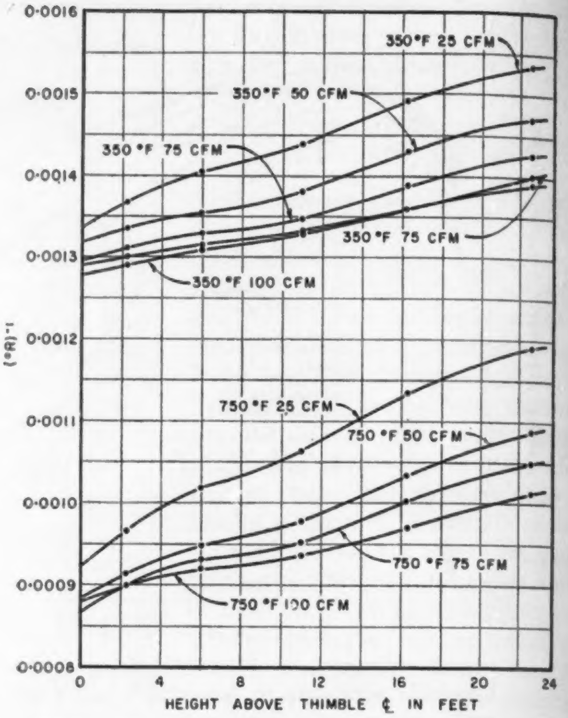


Fig. 7 Inverse of temperature at flue centerline in the NRC test chimney

temperatures at several flow rates were calculated and substituted into Equations (1) and (2) along with the friction factor K determined from the model tests.

The calculated efficiency–flow-rate curves are superimposed on the experimental results (Fig. 3). The theoretical curves agree well with the experimental results but do not agree with the design curves, especially at low chimney inlet temperatures and high gas flow rates.

Remaining records for all fourteen chimneys tested by Achenbach and Cole were analyzed as above using the model results for the different chimney shapes. This study showed similar agreement between calculated and observed performance. All these chimneys were tested in the range 85 to 320 lb/hr and showed efficiencies in the same range as those of Fig. 3. Each type of chimney construction, however, had its own specific efficiency — flow-rate relationship.

Draft performance of the NRC chimney — Although the above analysis appeared to confirm that Equations (1) to (3) could be used for chimney design purposes, some doubt remained as to the validity of the assumption that friction pressure-loss would be the same under isothermal and nonisothermal conditions. The NRC masonry chimney was operated therefore to obtain further records of draft for different chimney heights. This information can be compared with that given by Achenbach and Cole.

As pointed out, the draft in the NRC chimney was measured differentially between a point in the connecting duct near the thimble and the chimney. This method of measurement was necessary because even notably low winds over the chimney top were found to contribute significantly to the draft when measured in the usual way (i.e. between the ambient air and a point in the thimble). This effect was verified by simple wind tests on a model, which also offer support for the previously proposed method[8] of using models to study wind effects. (Results of these studies are given in Tables I and II.) By making differential meas-

Fig. 8 Comparison of non-isothermal and isothermal friction losses for the NRC test chimney. (Chimney inlet temp 350 F)

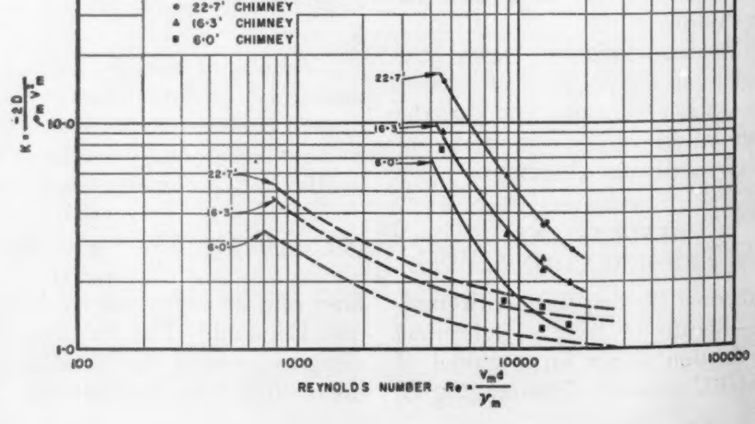


TABLE I

EFFECT OF WIND OVER TOP OF NRC MASONRY CHIMNEY

Draft measured differentially between thimble and a point 1 ft below chimney top	Draft measured between thimble and outside air	Draft induced by wind	Wind velocity	Wind velocity pressure	Ratio of draft induced to wind velocity pressure
0.012 to 0.014 in. water	0.039 in. water	0.025 to 0.027 in. water	9 mph	0.041 in. water	0.6 to 0.7

urements the net draft for no-wind conditions for different heights of chimney could be obtained without the necessity of building separate chimneys or having large openings in them at various heights (cf. 1).*

Test results for the NRC chimney, with flue gas inlet temperatures of 350 and 750 F are given in Figs. 4 and 5. Chimney efficiencies for the 16.3-ft chimney are in fair agreement with the results of Achenbach and Cole. Results for all three heights at 350 F inlet temperature agreed poorly with the Schmitt and Engdahl design curves at the higher flow rates, and in general agreed only approximately at lower flow rates. The relative performance of the three heights was not regular: at low flow rates the 6.0-ft chimney had the greatest efficiencies, while at high flow rates the efficiencies for the 16.3-ft and 22.7-ft chimneys were greatest. To check the effect on performance caused by chimney inlet conditions,

*Some authors (1, 4) claim a "stack effect" exists above the physical height of a chimney which causes an increase in draft in the absence of wind. However, there appears to be no experimental or theoretical evidence available to support this contention.

TABLE II

EFFECT OF A HORIZONTAL WIND OVER MODEL CHIMNEY TOP

Fan position	Draft induced by wind	Wind velocity pressure	Ratio of draft induced to velocity pressure
24 in. horizontally from chimney top	0.016 to 0.024 in. water	0.028 to 0.031 in. water	0.5 to 0.8
8 in. horizontally from chimney top	0.031 to 0.051 in. water	0.059 to 0.079 in. water	0.4 to 0.9

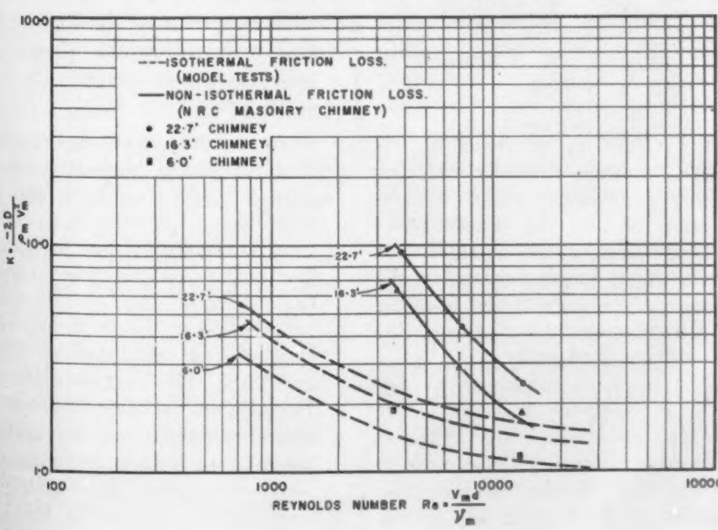
the air straightener was removed from the chimney thimble and tests repeated. Results were only slightly affected by this procedure. The values of F/R (Fig. 6) did not differ greatly from those of Achenbach and Cole, although values were somewhat greater for the 6.0-ft chimney than for the other two heights.

Since the differential method of obtaining draft measurements on the NRC chimney allowed more accurate results than previously obtained, an attempt was made to determine the actual friction losses occurring in non-isothermal flow. The measured value of ρ_m obtained from an average of the inverse of temperature at the chimney center-line (Fig. 7) was inserted into Equations (1) and (2), which were then solved for the non-isothermal friction factor K_n. Results (Figs. 8 and 9), although somewhat inconsistent, especially for the 6.0-ft chimney, show values much greater than for isothermal flow (model results given for comparison) except at high flow rates where convergence becomes apparent. Furthermore, it can be seen that the magnitude of K_n also depends on the chimney gas temperature.

The large friction factors obtained in non-isothermal flow can be clarified in part by a new theory for pressure loss and heat exchange in vertical tubes,[9] which indicates that the Grashof number, $\frac{gd^3\beta\Delta T}{\nu^2}$, influences the friction pressure loss as well as the heat flow. At low flow rates in the chimney tests the Grashof number was large in comparison with the Reynolds number and greatly influenced the friction losses. At these low flow rates the turbulence due to instability was much greater than that occurring in the normal isothermal turbulent range and the friction loss was consequently increased.

Although calculated chimney performance based on the isothermal friction losses appeared to correlate fairly well in previous work,[8] it now becomes clear that this method is only applicable to high flow rates and to a quite limited range of chimney sizes. In the

Fig. 9 Comparison of non-isothermal and isothermal friction losses for the NRC test chimney. (Chimney inlet temp 750 F)



size range of domestic chimneys large errors in estimating the friction factor K_n do not greatly affect the calculated chimney efficiency. For extrapolation of results for other sizes of chimneys the method suggested previously[8] should be modified to incorporate the non-isothermal factor K_n instead of K for isothermal conditions. In the present work the measurements were not sufficient to determine the manner in which K_n depends on the Grashof number, hence caution should be exercised in extrapolating figures. It is hoped that this matter can be further clarified at a later date. Since natural convection as evidenced by the Grashof number is present at low flows, mixing would always occur and chimney efficiency would not tend to zero as suggested by the Schmitt and Engdahl design curves.

CONCLUSIONS

Since friction losses were found to be much higher for non-isothermal flow than for isothermal flow, care should be exercised in extrapolating available results for other shapes and sizes of chimneys. In particular, old methods of design which simply assume friction losses in the vertical flue to be the same as for smooth pipes in isothermal flow are likely to be considerably in error. Before a complete design method for chimneys of all sizes can be proposed, a more thorough study of natural convection effects will be needed.

Tests on the NRC chimney were in essential agreement with other experimental work covering a narrow range of domestic chimney sizes. The design curves of Schmitt and Engdahl, however, appear to be considerably in error at high and at exceedingly low flow rates.

Incidental tests to study wind effects over the chimney top were verified by model results. This work in turn indicated that wind can be treated separately from steady-state performance and can be studied using models.

ACKNOWLEDGMENTS

R. G. Evans and J. E. Berndt assisted with construction and the recording of results and the authors record their thanks for this assistance. The authors also acknowledge guidance given to this project by A. G. Wilson, head of the Building Services Section in which the work was carried out.

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ASHRAE-Wolverine Award Recipients Met at Dinner in Vancouver

Award of the Wolverine Diamond Key for the best paper appearing in the JOURNAL in the most recent calendar year was made at the ASHRAE Annual Meeting in Vancouver to P. H. Zeil and J. S. Blossom authors of "Pressurizing High Temperature Water Systems", as reported previously. This paper appeared in November 1959.

On the last day of the Meeting all attending previous recipients of the Wolverine Key Award met in the Georgia Hotel with representatives of Wolverine Tube and guests for the first of what may be a series of testimonial dinners similarly linked with Annual Meetings of ASHRAE.

The gathering was addressed briefly by John M. Dumser, Director of Marketing, Wolverine Tube, Division of Calumet & Hecla, Inc. as follows:

> Year by year in all fields of endeavor, certain members of the various professions make a contribution beyond the requirements of their day to day assignments which, to a large degree, is the foundation for growth and progress of American technical knowledge and industrial capacity.
> People apply themselves to the study of problems and the exploration of ideas which are presented in written form and this represents an addition to the accumulated knowledge of the past and a contribution to the foundation of knowledge in the future. This is professionalism of the highest order and recognition to people who make this contribution is highly appropriate.
>
> Diamond Key Award winners are a select group of people who not only devoted their time and effort to study and preparation of a technical presentation but had the distinction of having their presentation selected as an outstanding publication in the field of refrigeration and air conditioning. Wolverine Tube, Division of Calumet & Hecla, Inc., is proud to be associated with this activity and takes pleasure in honoring the men who have succeeded in winning outstanding recognition in their field.

A look at today's

Absorption refrigeration

In a paper presented before the American Society of Refrigerating Engineers in June, 1949, the late A. A. Berestneff of Carrier Corporation, described the then recent line of lithium bromide-water vapor machines which had a capacity range between 115 and 200 ton. Author Johnson traces the improvements of the last 15 years and reviews the present day absorption refrigeration cycle.

S. E. JOHNSON
Member ASHRAE

Absorption refrigeration machines, practical and economical, have a present day capacity range extending to 1000 tons in single units. The modern units incorporate a number of improvements in design compared to the first machine introduced in 1947.

Separation of the chilled water cycle from the refrigerant cycle within the machine is perhaps the foremost improvement. Originally, chilled water returned from the air conditioning coils was flashed directly in the evaporator. After being recooled it was pumped back to the air conditioning apparatus. Hence, the whole chilled water piping system was required to maintain the low vacuum essential to operation of the absorption cycle. In effect, the chilled water piping network became a part of the refrigeration machine, which required certain design precautions increasing the cost of the water lines. In today's machine, the chilled water circuit is separate from and independent of the refrigeration cycle, which permits conventional treatment of the chilled water piping design.

The lithium bromide absorbent solution cycle within the machine has been improved by application of a quiet and efficient centrifugal pump to circulate absorbent solution to the absorber. Earlier machines used an eductor (jet pump) for this service. The pumping efficiency was low, and operation sometimes noisy.

Another improvement in the absorbent circuit is the use of an efficient cross flow solution heat exchanger which is simpler and smaller than the multi-section shell and tube exchanger on the original models.

The purge system on older units consisted of a steam jet and water jet in series. Although effective, this purge system was connected to auxiliary steam and water lines. System designers had to provide adequate water pressure and dry steam. The purge has since been made completely independent of auxiliary water and steam requirements.

In the present purge system (Fig. 3) the jet pump (1) produces a rather low absolute pressure at the jet suction. The jet fluid is lithium bromide solution, which is forced at high velocity through the jet pump by a motor-driven centrifugal sump pump (2). Lithium bromide solution is capable of producing the required suction pressure in a single jet when cooled to a lower temperature than the absorber solution temperature. Chilled water returning to the machine is the source of cooling for the coil (3).

The jet type purge has the ability to absorb water vapor from the mixture of water vapor and non-condensibles from the absorber and return the water vapor to the absorber. Previous purges discarded this vapor, necessitating automatic controls to replace the loss. Other purge systems, such as mechanical vacuum pumps, suffer damage from the water vapor. Avoiding this may require resorting to passing the water vapor-noncondensible mixture through a separate scrubber absorber or shutting down the machine manually to permit purging. The jet-type purge is fully automatic, operating intermittently only when purging is required.

The element of the machine which has undergone the greatest process of evolution is the control system. The aim has always been toward simplification and improved dependability. As a result, capacity at all levels is now controlled by simple regulation of solution flow to the generator.

The machine described by

S. E. Johnson is a Senior Applications Engineer, Carrier Corporation.

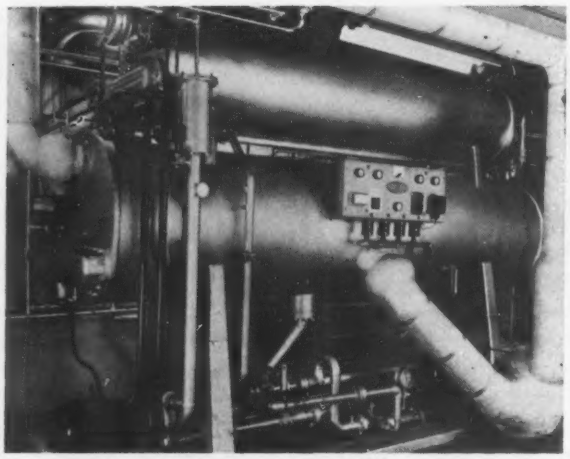

Fig. 1 First absorption refrigeration machine. Installed 14 years ago, it has 150 ton cooling capacity and has been in continuous operation ever since

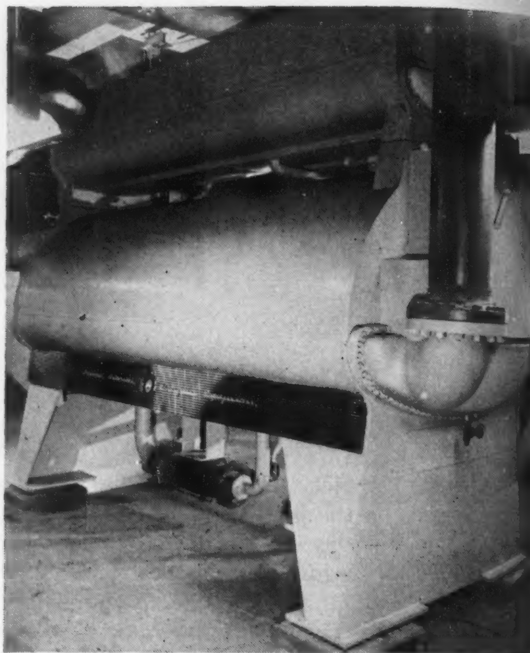

Fig. 2 A recent absorption machine with a cooling capacity of 387 ton

Berestneff in 1949 had a control system which operated to result in a steam consumption per ton which was virtually constant through a wide range of capacities. However, that machine could not be operated below a minimum of 10% load. When it became apparent that operation at virtually no load was highly desirable, changes were made to provide both simpler and more dependable controls which permitted operation down to no load.

The present control operates between zero and 100% load and assures that condenser water flow remains constant, steam pressure remains constant, and condensate return is simple and air fresh. Steam consumption and condenser water temperature decrease when the load decreases minimizing steam cost and tube sealing. The control is mechanically simple.

OPERATION OF MACHINE

Referring to the schematic diagram of the machine (Fig. 4) water to be chilled enters the unit, passes through the cooler tubes and exits at a lower temperature. Refrigerant water enters the cooler through a header (1) and is sprayed over the cooler tubes (2). Since the cooler is maintained at a low absolute pressure, the refrigerant boils and vaporizes as it receives heat from the chilled water by transmission through the cooler tubes. More refrigerant water is sprayed into the cooler than is vaporized, and this excess insures complete wetting of the lower tubes for maximum performance. Unevaporated refrigerant drips from the lower tubes into a collecting pan (3), drains into the evaporator pump suction connection and is re-cycled by the evaporator pump (4) back to header (1).

The low absolute pressure maintained in the cooler determines the refrigerant boiling temperature as well as the temperature of chilled water leaving the machine. The cooler pressure is maintained through the action of the absorber, which is a bundle of tubes (5) located in the same cylindrical shell as the cooler. Lithium bromide solution is sprayed (6) over the absorber tubes, and continuously absorbs (condenses) refrigerant vapor while simultaneously transferring heat of condensation and dilution to cooling water, which passes through the absorber tubes. The cooling water temperature determines the temperature of the lithium bromide. The lithium bromide temperature, and the lithium bromide concentration, together determine the absorber pressure, which is the same as the cooler pressure.

The lithium bromide solution flowing over the absorber tubes is diluted (reduced in concentration) by the water vapor absorbed. The lithium bromide leaving the absorber tubes has, therefore, partially used up its ability to absorb water vapor and is called a weak solution. A portion of this solution is continuously drained from the bottom of the absorber and pumped by the generator pump (7) through the heat exchanger (8) to the generator. Steam admitted to the generator tubes (9), which are submerged in the lithium bromide solution, revaporizes the water which was condensed in the absorber. The lithium bromide concentration is thereby increased.

Water vapor separated by boiling from the weak solution in the generator is reliquefied in the condenser. The water vapor contacts the condenser tubes (10), condenses by transfer of heat to the cooling water inside the tubes, and is collected as liquid in a collecting pan (11). The collecting pan drains by gravity, returning the liquid refrigerant to the cooler.

The path of the refrigerant through the machine has been completed. It starts in the cooler as liquid water, is vaporized by heat from the chilled water, and flows as vapor to the absorber. In the absorber the water vapor is condensed, but loses its separate identity by forming a solution with lithium bromide. The lithium bromide is pumped, weakened by the refrigerant it has absorbed, to the generator. In the generator, the re-

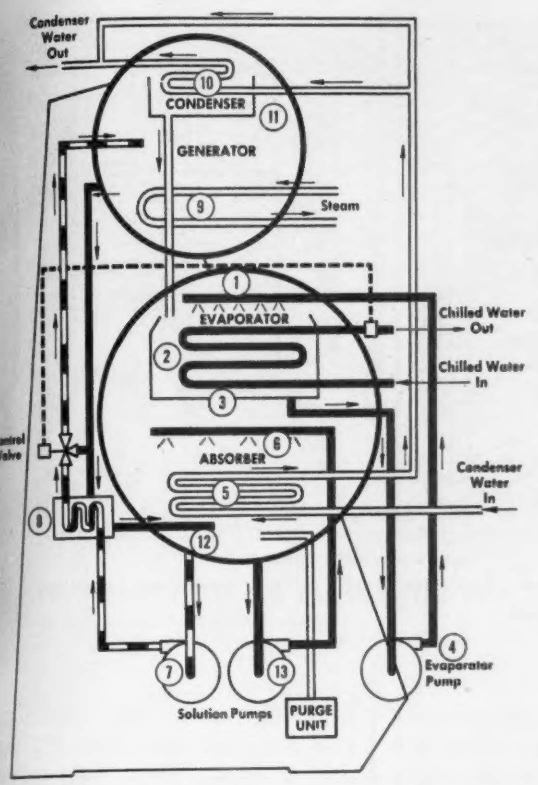

Fig. 3 Absorption purge system

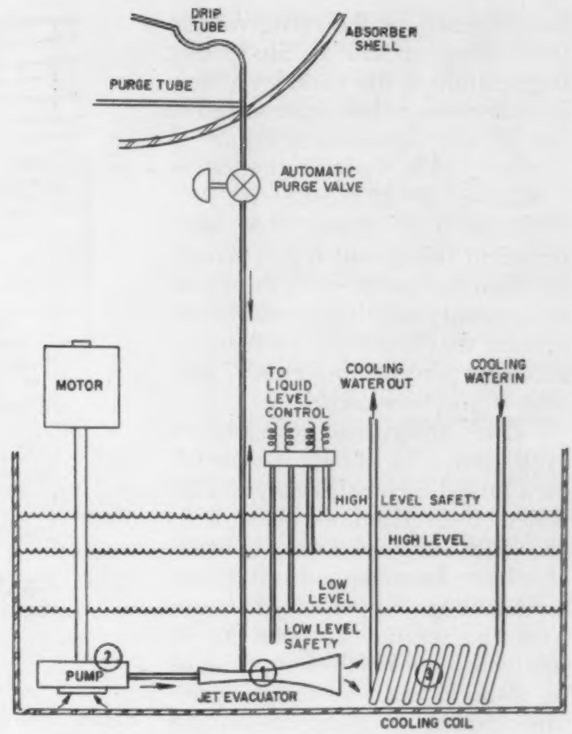

Fig. 4 Schematic diagram of the machine

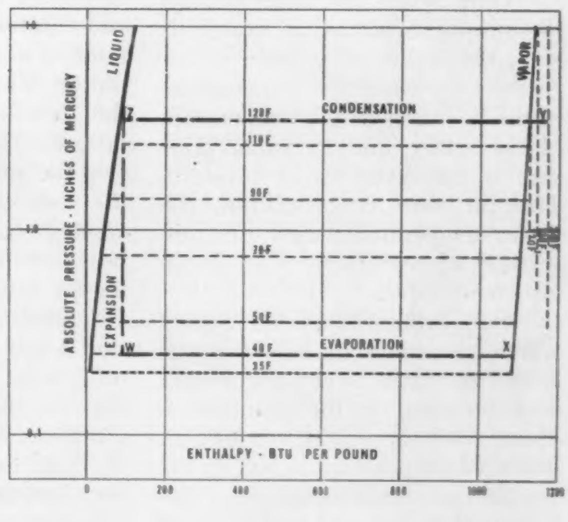

Fig. 5 Partial absorption refrigeration cycle on pressure – enthalpy diagram for water

frigerant regains its separate identity, being separated by boiling from the lithium bromide. The refrigerant flows as vapor from the generator to the condenser, condenses, and returns to the cooler as liquid, thus completing its cycle.

The lithium bromide circuiting starts in the absorber spray header (6). Relatively strong or concentrated lithium bromide solution is sprayed into the absorber, flows over the absorber tubes, and is weakened by taking water vapor into solution. The weakened solution is pumped through the heat exchanger, to the generator, boiled, and reduced in water content. Thus restored to high concentration, the hot, strong lithium bromide flows through the heat exchanger, transfers heat through the heat exchanger tubes to the weak solution, and is discharged (12) into the absorber under the absorber tube bundle.

All of the strong solution discharged into the bottom of the absorber is picked up by a second solution pump called the absorber pump. The absorber pump (13) also picks up a portion of weak solution, mixes the strong and weak solutions, and discharges the mixture, now of intermediate concentration, to the absorber spray header.

Strong solution is prevented from flowing to the generator pump by locating the strong solution discharge point adjacent to the absorber pump suction and remotely from the generator pump suction. The absorber pump is relatively large in capacity as compared to the generator pump and continuously picks up the entire flow of strong solution as well as some weak solution. The cycle is continuous although each part has been described individually.

REFRIGERATION CYCLE

As water is used as the refrigerant in the absorption machine, consider the pressure-enthalpy diagram for water (Fig. 5). Line W-X shows that at 40 F evaporating temperature and 120 F condensing temperature, the net latent heat available for refrigeration is the enthalpy difference of the vaporized refrigerant at 40 F (1079.3) saturated, and the condensed liquid at 120 F (87.9), or 991.4 Btu/lb of refrigerant in circulation in the cycle.

Line Y-Z shows that the net

heat rejected by the refrigerant in condensing at 120 F condensing temperature is the enthalpy difference between vapor superheated to 230 F and condensed liquid at 120 F. This heat quantity is (1163.8–87.9)=1075.9 Btu/lb.

Line Z-W shows that each pound of refrigerant liquid returning from the condenser to the cooler at constant enthalpy, partially vaporizes, thus becoming a mixture of about 93 percent liquid and 7 percent vapor by weight.

The absorption refrigeration cycle cannot be shown completely on a pressure-enthalpy diagram for water. Refrigerant at point X in Fig. 5 is absorbed into a solution of lithium bromide and water, and separated as superheated vapor from the solution at point Y. To complete the cycle, reference must be made to the water vapor pressure-solution temperature-solution concentration chart (Fig. 6) for a solution of lithium bromide and water.

Only when the concentration of lithium bromide in water is zero, the "solution" is pure water. At the same condition, temperature of the "solution" is the temperature of the water, and its vapor pressure is the water vapor pressure. Thus at zero concentration, the water temperature-vapor pressure relation agrees exactly with standard steam tables.

Pure lithium bromide is a solid which becomes a liquid when dissolved in water. When the weight concentration of the solution is above zero, vapor pressure remains water vapor pressure alone. As the weight concentration increases, solutions of higher and higher liquid temperature are in equilibrium with the same water vapor pressure.

The difference between the vapor pressure of a lithium bromide solution at a given temperature, and the vapor pressure of pure water at the same temperature may be referred to as the "dewpoint depression." For example, the "dewpoint depression" of 100 F 60% weight concentration lithium bromide is 1.93 in. h.g. minus .023 in. Hg. or 1.70 in. Hg. The "dewpoint depression" in terms of temperature difference is 100 F minus 38 F or 62 F.

Continuing the refrigeration cycle, refrigerant vapor point X (Fig. 5) is absorbed along line A-B (Fig. 6). As the refrigerant is absorbed, it reverts to a liquid state, giving up its heat of condensation and diluting the lithium bromide solution from its original concentration A to concentration B. Since the heat of condensation would raise the solution temperature and stop the absorption process by raising the solution vapor pressure, cooling water is used to remove heat from the absorber, thus keeping the solution temperature down.

Solution at reduced concentration B now contains the evaporated refrigerant. This solution, including the absorbed refrigerant, is pumped from the absorber through the heat exchanger to the generator, entering at temperature and concentration C. In the generator, the solution is first heated and then boiled. The boiling process disengages the refrigerant from the solution, resulting in solution at elevated concentration D. The refrigerant, again in the form of water vapor, flows to the condenser, point Y (Fig. 5).

Solution at elevated temperature and concentration D, returns by gravity to the absorber, gives up heat in the liquid heat exchanger and enter the absorber at temperature and concentration E. The heat given up by the hot solution is cooling from the elevated temperature at D to the lower temperature E heats the weak solution from the low temperature at B to higher temperature C. The solution at temperature and concentration A, which does the actual refrigerant absorbing is obtained by mixing solutions E and B.

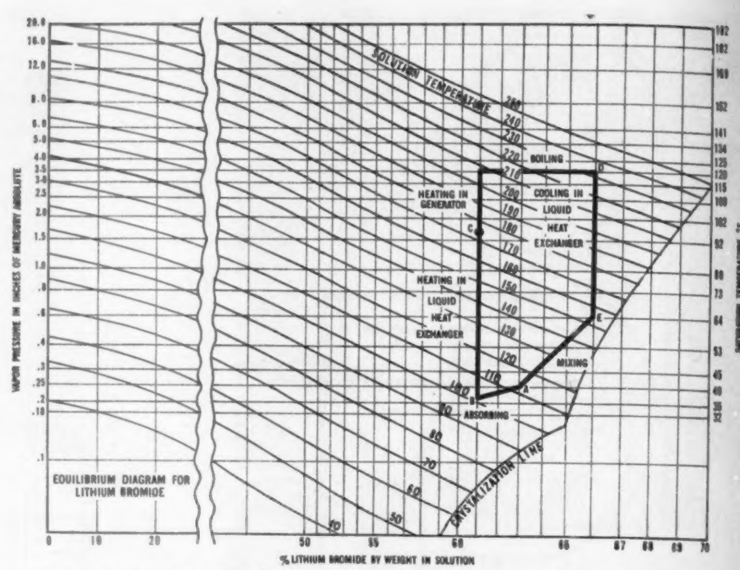

Fig. 6 Full load absorption cycle on a temperature-pressure-concentration chart

PART LOAD CYCLE

The recent control governs machine capacity by regulating the concentration of lithium bromide solution at condition A (Fig. 6). This is accomplished by a three-way diverting valve (Fig. 3) responsive to the chilled water temperature. The valve either permits a maximum flow of the weak solution as at B (Fig. 6) to enter the generator for re-concentration, or proportions the flow to the generator and the strong solution side of the liquid heat exchanger. Steam pressure and condensing water flow are kept constant.

The effect of diverting a portion of the weak solution on the partial capacity lithium bromide cycle is shown in Fig. 7. Cycle A-B-C-D-E is a full load cycle identical to the one shown in Fig. 6. Cycle A′-B′-C′-D′-F′-E′ is at 50% capacity, while A″-B″-C″-D″-D″-E″ is at 10% capacity.

The partial load cycle reveals that proportioning the weak solution flow results in progressively higher maximum generator concentration D and D′, and progressively lower condensing temperatures of 120, 105 and 90 F as load

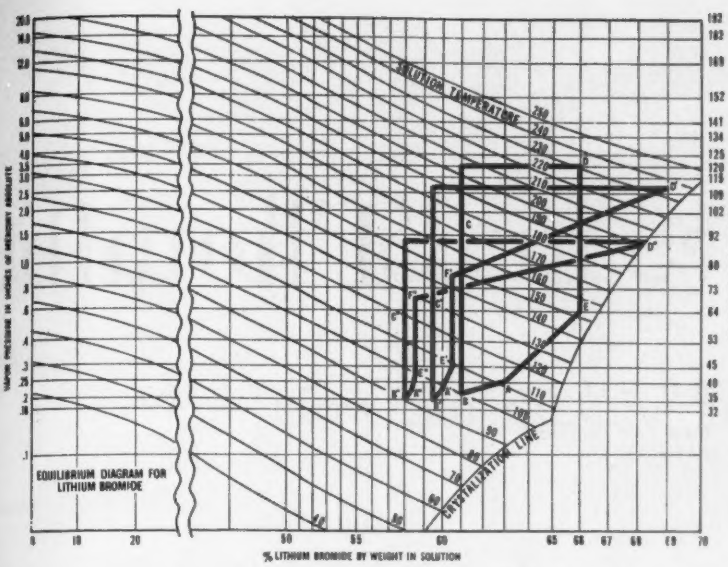

Fig. 7 Full and partial load absorption cycle on a temperature-pressure-concentration chart

diminishes. (D″ is a mixture of liquid crystals and has a net lithium bromide content higher than D′.) Mixing lines D′ - F′ and D″ - F″, indicate progressively lower strong solution concentrations returning via the heat exchanger to the absorber at E′ and E″. Concentrations E′ or E″ mix with concentrations B′ or B″ resulting in the progressively lower concentrations A′ and A″ which do the actual refrigerant vapor absorption.

Permitting the maximum generator concentration to increase to partial crystallization (a slushy crystal-liquid mixture) at rather low capacity has decided advantages. The highly concentrated lithium bromide, which is in effect stored in the generator when capacity requirements are low, is immediately available to satisfy increased capacity requirements with a minimum time lag. Partial crystallization is localized and confined to the generator. It is impossible for crystals to leave the generator without being immediately mixed with low concentration solution and reliquefied before entering the heat exchanger.

Proportioning the weak solution flow to the generator is not only a highly effective method of controlling capacity, but it is also principally responsible for achieving extremely good part load performance.

Steam consumed in the generator at any load is used three ways. Most of the supply is required to vaporize the refrigerant and is almost directly proportional to refrigerant quantity, which in turn is proportional to the load. The least amount is the heat of solution (also called heat of dilution), which is usually expressed as Btu/lb of water added to, or removed from, solution. This is a positive heat quantity when water is added to lithium bromide, and is also proportional to refrigerant quantity.

The third demand is for sensible heating the lithium bromide solution flowing through the generator from inlet to outlet temperature. This part of the total is not proportional to refrigerant quantity, but is proportional to weight flow of solution and to temperature increase.

The partial load steam rate will remain equal to full load steam rate, or will increase or decrease depending upon the effect of the control system on the sensible heating component. Reducing the solution flow for partial load operation to a minimum, reduces the sensible heating required to a minimum, thus giving the best possible part load performance.

The degree to which solution flow is reduced can be determined by examining the full load and 50% load cycles shown in Fig. 7. At full load (cycle A-B-C-D-E) the ratio between absorber flow and generator flow is 2.5 to 1 (5% concentration change in absorber to 2% concentration change in generator). At 50% load (cycle A′-B′-C′-D′-E′-F′) this ratio becomes 9.5 to 1. Since absorber flow is constant, generator flow at 50% load is 2.5/9.5 × 100 = 26.3% of full load flow.

Centralized controls prove economical

Allegedly paying for themselves in some instances in less than three years, such console-type control centers as are illustrated on the cover of this issue depend upon pneumatic transmission instruments for their effectiveness and to provide simplified, trouble-free operation.

Numerous functions can be performed through the use of pneumatic control centers. Instead of making the rounds of several separate equipment rooms, the building engineer can start and stop motors, fans, compressors, pumps, and other equipment from the panel.

The centers also provide a continuous visual check of all of the key temperatures and pressures throughout the building. These include room temperatures, hot and chilled water discharge temperatures, hot and cold air supply temperatures, return air temperatures, outdoor air temperature, and others as required. The indicators show the position of controlled devices, such as valves and dampers.

Any necessary adjustments can likewise be made without leaving the panel. As a guide in making correct decisions, this Johnson Service Company center contains color-coded graphic representations of all systems and their controls. These may be incorporated on the panel itself, or projected on a screen. Permanent or plug-in recorders furnish records of data.

R. H. TULL

First Vice President
ASHRAE

The allied

The second paragraph of the By-laws of this Society, Section 1.2, states: "The object of the Society is to **advance** the arts and sciences of Heating, Refrigeration, Air Conditioning, and Ventilation, and **the allied arts and sciences** for the benefit of the general public." The breadth of the professional interest of our Society is indicated by this statement. This breadth of interest brings great strength to the Society in many ways, but at the same time it brings problems which must be recognized and dealt with.

That these problems would exist was recognized by the committee which framed the By-laws of the new Society. Over and over again in the By-laws arrangements are provided to protect the professional interests of all members of the Society and at the same time to maintain a balance between these interests within the Society's organization. For instance, nine members of the Board of Directors, the Directors-at-Large, must be chosen with equal distribution from the three major areas of membership interest. Furthermore, the By-laws require that six of the members of the Nominating Committee must be selected by the Board of Directors so that two members shall represent each of the three major areas of membership interest.

As a further safeguard, the By-laws established a Divisional Advisory Committee made up of the nine Members-at-Large of the Board of Directors. It is the duty of this committee to "review and advise the Board of Directors, when it deems that any area of membership professional interest is not being duly represented or recognized."

The By-laws further provide that "whenever twenty five (25) or more members in a chapter, or two hundred (200) or more members rationally signify their desire to carry out a program at the chapter level or national level, respectively, in a specialty within the fields defined in Section 1.2, this committee and the Board of Directors shall provide all reasonable facilities customarily provided to other specialties." Thus ASHRAE, which came into being through the merger of special interests groups whose common interests provided a basis for the merger, is specifically and exceptionally well-organized to serve its own three major areas of professional interest and also "the allied arts and sciences."

Each of the areas of major interest could, of course, be broken down into a great number of special and detailed interests which comprise its total field. In general, it appears that both at the chapter level and the national level through its variety of programs and publications, ASHRAE is serving these major areas of professional interest quite well. There is, of course, always room for improvement, and we must continually strive to do better. In this connection, we earnestly solicit the suggestions of individual members regarding new and improved programs and services the Society can provide.

Our services to the "allied arts and sciences," however, involve some real problems.

What are some of these allied arts and sciences, and what problems do we face? The following list is certainly not all-inclusive, but will serve to illustrate fields of engineering art and science which are allied to the major fields of Heating, Refrigeration, and Air Conditioning:

Industrial ventilation
Food and beverage processing and storage
Air treatment
Cryogenics
Psychrometry

The connection is in all cases quite obvious. Some of these fields represent major areas of industrial activity, while others represent advanced areas of research in engineering. But all of them are of real importance to the total field of engineering

R. H. TULL
Guest Sponsor

arts and sciences

How can they be advanced?

activity covered by ASHRAE. The engineers who are active in each of these fields are interested in many of the activities of the ASHRAE major fields of interest. Our problem is how to advance the specific interests of each of these groups within the framework of our Society organization and program.

The principal services the Society can provide to help advance these allied arts and sciences are in the areas of technical programs and discussions, publications, standards, research, and professional development. At both the chapter and the national level the Society provides opportunity for the presentation of technical papers, technical conferences and group discussions. At the chapter level these activities need not involve the whole chapter in cases where a small group of engineers would like to get together under the chapter auspices for technical discussion of a highly specialized subject. This is being done through the device of coffee talks, separate but concurrent technical sessions, small group conferences, etc. We should seek new approaches to this type of activity at the local level to provide the best possible technical programs for these special interests groups.

At the national level in connection with the Annual and Semiannual Meetings, there is opportunity for technical forums, conferences, and concurrent technical sessions, depending upon the nature of the subjects and the extent of interest. All of these techniques are being followed at the present time and can be extended to serve any group which will take the initiative to develop a program meeting the general requirements of the Program Committee. An excellent example of this type of activity in the Domestic Refrigerator Engineering Symposium which has become a most important element in our technical programs. This type of conference can certainly be extended to cover any of the technical fields in which such conferences are warranted. Thus, in the area of technical programs there are established techniques and activities available which can be extended to cover the allied arts and sciences.

The area of publications is considerably more complicated. Because of the cost of publication and the essential importance of planning the JOURNAL to give the broadest possible readership interest, it would be unwise publication policy to devote an undue share of the publication space in the JOURNAL to any of these special areas of interest. Every effort must be made to maintain a proper balance, but it is entirely possible that this proper balance does not adequately cover the technical material developed in the most active of these special interest areas. In such cases, consideration should be given to supplementary publications such as special bulletins, conference reports, etc. printed for distribution to the limited, interested circulation at cost. Whether or not the technical material originating in these special groups should be included in the regular volumes of the GUIDE AND DATA BOOK or in some other form is another problem in the publications area. It should be pointed out here that, as stated in the By-laws, the object of the Society is to advance these "allied arts and sciences" and every consideration must be given to developing ways and means of accomplishing this objective.

In the areas of standards and research, the facilities of the Society are available to carry out any programs approved by the Board of Directors in connection with these special interest groups.

The solution to the problems of adequate participation and representation in the various activities of the Society by these special groups must not lie entirely with the officers and committee organization of the Society. Much of the initiative for applying the services of the Society to these special interest areas must come from the special interest groups themselves. The objective of the Society is clearly stated. The organization is specifically set up to carry out this objective. The officers and the committee chairmen recognize their responsibility to do so. Wherever a need can be established, we are willing and eager to consider ways and means of providing services which will add strength to the Society and further its objectives.

Open display cases

in food stores preoccupy engineers at Commercial Refrigeration Symposium

Supermarkets are using refrigerated open display cases in ever increasing numbers and as a result encountering problems which can only be considered in true perspective in relation to store air conditioning.

At the Commercial Refrigeration Symposium in Vancouver, three speakers assailed as many aspects of the matter and furnished some excellent views upon which to build future equipment and installation designs.

Effects on the air conditioning load

D. E. FRIEDMAN
Associate ASHRAE

It is clear that the ambient will have a major effect on the refrigeration requirements of an open display refrigerator. Frequently questioned is the effect the refrigerated equipment has on the food store air conditioning load.

The data which follow were obtained under controlled test room conditions using a standard 12 ft open type frozen food display case. Three test points were selected in order to obtain data under ambient conditions of:

1. Constant moisture content, variable temperature and
2. Constant temperature, variable moisture content.

The intent was to control the refrigerated air returning to the evaporator to the same average temperature for all three test points. This was difficult, due to the effect of cycling of the refrigeration machine and the changes that occur automatically as the flues and the evaporator collect frost. The variation, however, was held within reasonable limits and the variation should not appreciably affect the conclusions reached.

A complete calorimeter test of the 1½ hp refrigeration machine was performed to determine the actual refrigeration effect. The following data were gathered at each point.

1. Test room temperature.
2. Test room relative humidity and wet bulb temperature.
3. Display case return air temperature.
4. Display case discharge air temperature.
5. Duration of test.
6. Running time of refrigeration unit.
7. Suction pressure.
8. Condensing pressure.
9. Weight of condensed frost on evaporator.

In order to obtain the refrigeration expended in converting the moisture in the infiltration air to frost, calculations were required. The difference in enthalpy between vapor at test room temperature and frost at evaporator temperature was figured and multiplied by the rate of frost formation on the coil. The calculations are shown in Table II. By deducting the latent heat load from the total refrigeration capacity the sensible heat load is obtained (Table III).

Note that the Test Point #3, which is closest to air conditioned store conditions, shows that sensible heat is over 90% of the total heat load. Also, taking the heat from the electrical accessories of the display case into account, the net refrigeration effect of the display case on the air conditioning is vastly reduced. It seems reasonable to conclude from this data and calculations that:

1. For purposes of calculating the effect of the display case on the store air conditioning, the ef-

D. E. Friedman is Chief Engineer, Hussman Refrigerator Company.

TABLE I
LATENT HEAT LOAD ON EVAPORATOR

	Test Point #1	Test Point #2	Test Point #3
Enthalpy of moist room air — Btu/lb	1102	1096	1095
Enthalpy of frost on evaporator — Btu/lb	—172	—173	—173
Difference in enthalpy — Btu/lb	1274	1296	1268
Rate of frost formation — lb/hr	.454	.425	.269
Latent heat load on evaporator — Btu/hr	580	540	340

TABLE II
SENSIBLE HEAT LOAD ON EVAPORATOR

	Test Point #1	Test Point #2	Test Point #3
Refrigeration Unit Capacity — Btu/hr	4500	4320	4320
Running time of refrigeration unit — %	100	92.5	87
Actual total refrigeration — Btu/hr	4500	4000	3760
Latent Heat Load — Btu/hr	580	540	340
Sensible Heat Load — Btu/hr	3920	3460	3420
Ratio Sensible Heat to Total Heat	.87	.865	.191
Heat Load From Case fans and heaters Btu/hr	1810	1810	1810
Net Refrigeration—Btu/hr	2690	2190	1950

fect of this frozen food case on the store air conditioning should be considered as a sensible heat effect only.

2. The net effect of this 12 ft frozen food fixture is less than 156 Btu/hr/ft of case (1950 Btu/hr. @ Test Point #3 ÷ 12 = 163). This is such a small amount that it generally can be omitted for most food store air conditioning calculations.

The effect of air conditioning on the operation of the display case can also be studied in two parts:

1. The effect of differences in the moisture content of the air and
2. The effect of differences in ambient temperatures

The effect of moisture content is obtained by comparing Test Points #2 and #3. Correction must be made for the test variation in ambient temperature and display case air temperature.

Normally, one would expect that for a 15% reduction in temperature difference a 15% reduction in refrigeration load would be realized. This is not true, since the heat load, due to fan motors and other electrical loads, remains constant. Calculations shown in Table III agree with the test findings.

TABLE III
EFFECT OF REDUCTION OF AMBIENT TEMPERATURE ON REFRIGERATION LOAD

Total	4500	4000
Fans, etc.	1810	1810
Net	2690	2190
Latent	580	540
Sensible	2110	1650

Change in sensible heat load 2110 − 1650 = 460

% decrease in total refrigeration $\frac{460}{4500} = 10.2\%$

% decrease in sensible temperature difference $\frac{100—85}{100} \times 100 = 15\%$

This series of tests shows that the open top frozen food display refrigerators are sensitive both to store temperature and store humidity. Properly designed, store air conditioning can provide a major reduction in refrigeration load. A reduction in store temperature from 85 to 75 F brings about an 8½% reduction in refrigeration load. A reduction in store humidity from 65% relative humidity to 45% relative humidity (75 F store) will reduce the refrigeration load for the display cases by 16%. In addition, the lower store humidity will mean less frost load on the evaporator, allowing more efficient heat transfer, shorter defrosts.

Since other types of open display cases are also used in food stores, additional testing such as presented here is necessary before final conclusions can be reached.

Control natural drafts in the area

THOMAS TYLER
Associate ASHRAE

Display refrigerators used for reference here consist of a cooled area of some depth, open at the top for access. The product is refrigerated by an air current moving horizontally across the top of this open well. This air is in turn chilled by an evaporator mounted in the bottom, back or front of the well. The refrigeration load of this open case consists of three parts, wall loss, product load, and ambient load.

The ambient load is the greatest source of heat addition to the display equipment and represents the greatest hindrance to good operation. Also, of course, this is af-

T. Tyler is Director of the Product Development Department, Tyler Refrigeration Corporation.

fected directly by air conditioning. This load is a combination of air change load, vapor diffusion and radiant heat load.

Radiant heat load is becoming more important, as air conditioning and better case design are decreasing the former two ambient load sources quite effectively. This, of course, depends upon display temperature and such other items as wall or ceiling temperature. In many cases, the store ambient temperature may not be indicative of the problem as a warm ceiling radiating directly into an open case can create quite a heat load without affecting the ambient.

A good rule of the thumb is that open case heat load is divided into fifths with about 2/5 coming from radiant sources, 2/5 from diffusion and air change loads, and 1/5 due to wall leak and product load. Consider some of the problems of air conditioning in relation to the food store.

Drafts—The location and type of inlet and outlet grilles for the air handling portion of the air conditioning and heating system are quite important. Near the display level any ambient air velocity in excess of 50 fpm would be considered excessive as air moving more rapidly than this in proximity to the case well will create turbulence and actually pull refrigerated air out of the open case.

1. Duct System — Air outlets should be of the diffuser type, if possible located in the ceiling — away from refrigerator case locations. Air returns should be through the rear store doors to the back room or located in such a way as to avoid any air flow near the cases.

2. Unit Heaters—These should be directed away from any possible contacts with the cases. Quite often the winter time load due to a unit heater blowing warm air into the case can be greater than a summer load in a non-air conditioned store.

3. Doorways — Cases must be located so that air blasts from outside doorways do not create drafts adjacent to the refrigerated zone. The problem of drafts actually is rather easy to avoid. With proper preplanning, it is possible to have all air currents in the sales cabinet areas never exceeding 25 fpm.

Humidity—The mechanism for heat removal by the open refrigerator is partially radiant. In a well designed store, approximately 40 per cent of the heat load imposed on the case is by radiant means. This is even higher in some of the new vertical open front merchandisers. This results in store cooling with little moisture removal, giving fairly high relative humidities.

The designer of the air conditioning system must take into consideration and create a heat transfer system with a high potential for removing latent heat, which would indicate an undersized evaporator. If he does not allow for the sensible air conditioning effect of the cases, high ambient humidities will result with an uncomfortable atmosphere and condensation on many areas of the cabinets. Oversized air conditioners have created humidities so high that if the night had been cool, the grocery shelves would sweat in the mornings and the labels on the cans would peel.

Swamp Coolers — Swamp coolers must be used where outside air is so dry that evaporative cooling will not present a high humidity. Also they should only be used where large open spaces are available to absorb drafts.

Radiant Heat—Radiant heat transfer in open equipment is rapidly becoming a major problem. Any open cabinet will expose the product to the mechanism of radiant heat from varied sources. Warm interior surfaces, such as walls or ceilings, must be avoided by careful insulation and ventilation. Lighting from windows or internal fixtures must also be governed, so that no product receives over 100 foot candles of light intensity.

This radiant problem also works in reverse. With the advent of vertical multiple shelf mechanizing, mass refrigerated areas are being created in a vertical plane. Radiant heat transfer is thus taking place in a horizontal path and shoppers have become the prime targets.

Air conditioning a food supermarket is not as simple as ordinary comfort cooling. Drafts must be absorbed at all costs, radiant heat sources must be kept to a minimum by proper ventilation and insulation, and calculations must include a negative heat load caused by the open display equipment drawing heat from the store and reducing mainly the sensible heat load.

Keep ambient humidity down

Conditions at which condensation occurs on open display equipment depend largely on ambient store conditions and design of the equipment. The design of the equipment, of course, has to do with the thickness and type of insulator and the refrigerator temperature desired.

High humidity in air conditioned stores can be caused by an oversized air conditioning system which is short cycling, by large openings permitting high humidity air to enter the conditioned space, or by a system designed with a high sensible heat ratio that does not remove the latent heat present. Under controlled ambient conditions, such as could be experienced in a well air conditioned store, the refrigerator surface temperature becomes the essential element to any condensation.

J. A. BIGGERS, JR.
Associate ASHRAE

Conditions at which condensation occurs within open display equipment also depend upon the relative humidity of the store air and the quantity of this air that finds its way to the interior of the refrigerator. In open display equip-

J. A. Biggers, Jr., is Director of Engineering, Ed Friedrich, Inc.

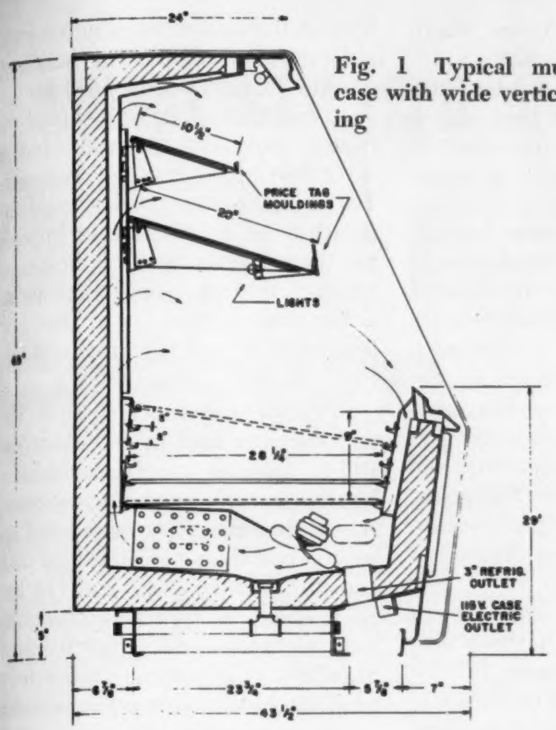

Fig. 1 Typical multi-shelf case with wide vertical opening

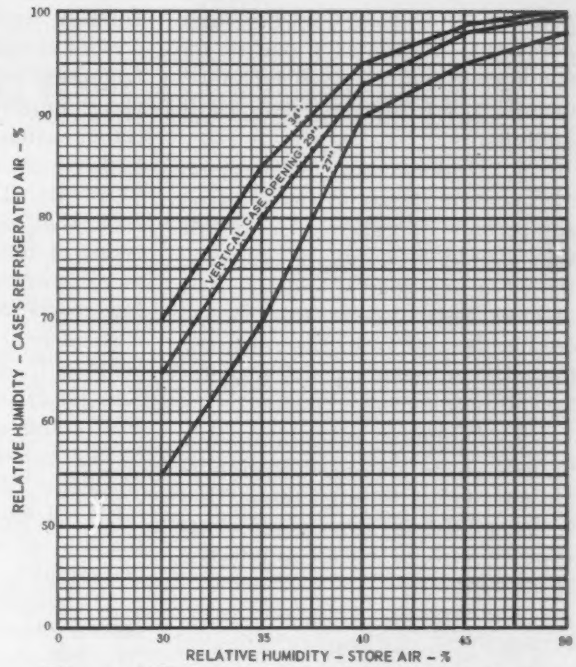

Fig. 2 Effects of store air humidity on refrigerated air in cases (Constants: Room air, 80 F; Case air, 5 F)

ment, particularly the multi-deck type, which boasts large vertical openings (Fig. 1), it becomes quite difficult to prevent a certain amount of spillage of refrigerated air due to method of loading the case, air movements created by customer traffic past the open front equipment, and air movements from the air conditioning system. This spillage creates a need for make-up air which is the moist store air. This is the specific instance where relative humidity of the store becomes a rather important factor, since a slight increase in humidity of store air creates a great increase in humidity of the case air.

Table I illustrates the effects of room air humidity on low temperature equipment (5 F), with different size vertical openings. At 50% rh, the relative humidity of the case air goes as high as 99.8%. This heavy moisture-laden air is visible and forms frost on the interior surfaces of the case as well as on the product in it.

Similar results were obtained in tests of a medium temperature refrigerator with equivalent vertical openings.

The data contained in Table I are presented in graphic form in Fig. 2. These indicate the necessity of keeping the store humidity as low as possible.

Take the example of a multi-shelf freezer with a vertical opening of 27 in. Although store humidity is only 40%, the case air humidity goes over 90%. The moisture content of store air (80 F db and 40% rh) is 61 grains/lb of dry air, and that of case air (5 F db and 90% rh) is 6 grains/lb of dry air. This means that every time a pound of outside air enters the case it gives up 55 grains of moisture in the form of condensate at different places within the case. If the store air is increased to 50% rh, the moisture content increases to 77 grains or 26% more. Thus, holding store humidity low is a most important factor.

The air conditioning system should be adjusted to maintain an average relative humidity of 50% for maximum comfort conditions and minimum condensation on refrigeration equipment. Many air conditioning systems, which are oversized or poorly designed, aggravate the humidity problem by maintaining low dry bulb temperatures with extremely high relative humidity. In this case, since the heat load on the walls of the refrigerator is reduced by the store dry bulb — the outside surface temperature will decrease to a point where condensation is possible. In addition the higher humidity condition indicates that the moisture in the case will have a higher dew point. This has been known to actually cause sweating of building walls and floors.

More complete control has been accomplished in various installations by:

1. Installing a reheat system in the air conditioning system. This addition of heat is necessary for continued operation of the condensing unit in marginal weather conditions, when little or no air conditioning is required to maintain comfort conditions. Besides com-

TABLE 1

EFFECTS OF STORE AIR HUMIDITY ON CASE'S REFRIGERATED AIR OF 5 F WITH STORE TEMPERATURE A CONSTANT 80 F

Store Air R.H.%	Case Air R.H.% with Vertical Case Opening of 34 in.	29 in.	27 in.
30	70	65	55
35	85	80	70
40	95	93	90
45	98	98	95
50	99.8	99	98

pensating for quite low coil temperatures — it creates a load on the condensing unit to prevent short cycling and a resultant increase in humidity.

2. Under-sizing the capacity of the system so as to cause longer compressor operation. Consideration should certainly be given to the 24 hr heat load calculation procedures and also to the cooling credits derived from the refrigerators. It can mean a sizeable reduction in hp.

3. Designing evaporators so as to gain more dehumidification of the air passing through them. That is by adjusting rows deep, face velocity, cfm, or by a combination of all methods.

The areas for condensation occurrence in and on refrigerated open display equipment are generally the same in air conditioned or non-air conditioned stores. The degree and extent of the problem is, of course, much less in an air conditioned store and can be corrected by relatively simple adjustments to the air conditioning system.

Exterior Surfaces — The more common problem areas of condensation on the exterior surfaces of the refrigerator are:

1. Building walls and floors shielded from radiation and air circulation by a refrigerator.

2. Refrigerators that are placed back to back with no provision for circulation or radiation will generate condensation on the shielded surfaces.

3. Non-insulated refrigeration lines and drain lines.

4. Around doors and joints where improper sealing permits leakage of refrigerated air.

The results of exterior condensation are apparent where the finish on the refrigerator deteriorates, oxidizing (rust) of metal surfaces begins, mildew forms, and wood starts swelling and warping. These effects can spread to the building and surrounding areas and create damage by rotting the flooring under the refrigerator, and warping or "floating-away" of applied floor coverings. If condensation is severe enough, it can create a safety hazard by permitting floors to become slick with moisture.

Interior Surfaces — Areas where condensation occurs within a refrigerated open type display case are generally surfaces that are in direct contact with refrigerated air and which are exposed to warm moist air. This creates a wet surface that can deteriorate certain types of finish, cause oxidation of metal surfaces, and in the case of low temperature equipment create a surface of ice that continues to build up and if permitted to get into joints or crevices of the case, may cause structural damage due to the extreme pressures that ice can exert. There is also the possibility of moisture migrating into the insulation which results in loss of insulating qualities.

The effect on the product inside the refrigerator in the above freezing applications may be the "melting" of the carton or package, getting the product soggy, spoiling the product inside the package, and oxidation (rust) of metallic containers. Products below freezing will be confronted with condensate which will freeze the packages together or build up ice or snow on the containers. Cartons with torn labels result, and will seldom, if ever, be purchased. The effect on the consumer is uncomfortableness and dislike in handling damp, clammy, soggy products.

Build up of light dry frost on frozen products generally has a favorable effect on the consumer. To many, it is a psychological indication of coldness that appeals to them because it indicates a product that is supposed to be at a low temperature, is at that low temperature and the frost reminds them of fresh, dry snow.

Condensation occurring on the coil surfaces and other non-accessible interior surfaces seldom causes damage to the refrigerator. A certain amount of frost build up on the coil does not affect the heat transfer factor of the coil but has been found to be advantageous as long as circulation is not blocked. Should a coil become prematurely iced or blocked due to excessive moisture in the air it would result in higher than required temperatures in the refrigerated display areas and if permitted to remain for extended periods could result in spoilage and shrinkage of the product. The effect on the consumer would be to pass up warm or soft products while the effect on the owner of the store would be a resultant loss of sales and consumer's good will.

In some areas the use of a low thermal conductance material is adequate to overcome a condensate problem. An example would be the use of low conducting plastics material on the inner surface of low temperature case ends and the use of plastics or rubber breaker strips between the inner and outer panels. Other areas may require the use of heater elements, such as handrails, slide door tracks, coils (for defrosting), price tag moldings or other trims, air ducts in low temperature equipment, and between back to back case installations. Still other areas require treating the surface with insulating material. Examples of this are suction and drain lines, shelves, some interior and exterior panels. Finally, some outside surfaces are corrected simply by creating or permitting free air circulation over the surface. An example would be the use of a small fan or blower to create free circulation in shielded areas, such as cases against a wall or back to back cases.

WHO'S WHO IN ASHRAE

Insofar as possible, these listings will each appear twice a year

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REGION AND CHAPTER OFFICERS
See page 90, May JOURNAL

RESEARCH AND TECHNICAL COMMITTEES
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STANDARDS PROJECTS
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INTER SOCIETY COMMITTEES
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Chairman:
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1.3 PSYCHROMETRICS

Chairman: W. L. McGrath
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G. O. G. Lof
Gumar Pleijel
Maria Telkes
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Chairman: B. A. Phillips
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R. C. Hartman
C. O. Hutchinson
D. E. Kvalnes
W. O. Walker

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W. J. Huth
J. B. Kelley
E. S. Ross

1.10 BRINES
Chairman: W. O. Walker
J. D. Bopp
A. H. Lawrence, Jr.

1.11 THERMAL INSULATION AND VAPOR BARRIERS
Chairman: C. F. Pridmore
Secretary: F. J. Powell
J. M. Barnhart
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Anthony Hass
G. A. Kelley
E. R. McLaughlin
H. E. Parker
T. G. Roehner
G. L. Simpson
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Group 2—Basic Equipment—H. P. Soumerai, Coordinator

2.1 RECIPROCATING AND ROTARY COMPRESSORS
Chairman: M. W. Garland
J. A. Galazzi
S. B. Nissley
H. P. Soumerai

2.2 CENTRIFUGAL AND AXIAL FLOW COMPRESSORS AND BLOWERS
Chairman: J. R. Chamberlain
H. Caswell
C. A. Macaluso

2.3 ABSORPTION AND STEAM JET REFRIGERATION
Chairman: E. P. Whitlow
P. P. Anderson, Jr.
G. R. Bell
Louis Leonard
H. L. Smith, Jr.
E. Spencer

2.4 COILS, FAN-COIL UNITS, AIR-COOLED CONDENSERS
Chairman: O. J. Nussbaum
R. M. Armstrong
W. J. Donovan
S. J. Gianni
B. P. Morabito
C. C. Smith
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D. B. Zipser

2.5 LIQUID HEAT EXCHANGERS—WATER-COOLED CONDENSERS
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C. E. Drake
H. E. Rex

2.6 WATER CONSERVATION EQUIPMENT, WATER TREATMENT
Chairman: W. J. Donovan
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T. Facius
F. W. McKenna
R. H. Savage
R. M. Westcott

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Group 3—Auxiliary Equipment—V. D. Wissmiller, Coordinator

3.1 CONTROLS AND VALVES
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P. O. Penn
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3.2 MOTORS AND MOTOR STARTERS
Chairman: A. P. White
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E. C. Kennedy
C. W. Kuhn
W. H. Thais

3.3 PUMPS AND PIPING
Chairman: M. B. Goddard
D. B. Gardner
R. T. Murphy
D. E. Perham
W. V. Richards
E. R. Teske

3.4 INSTRUMENTS AND INSTRUMENTATION
Chairman: H. M. Hochreiter
H. A. Sholl
F. A. Thomas
B. Willach

Group 4—Systems—S. W. Brown, Coordinator

4.1 COMFORT AND INDUSTRIAL AIR CONDITIONING
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J. R. Duncan
H. L. Galson
G. Higginbotham
J. D. Kroeker
W. A. Lotz
O. W. Motz
J. Schmidt
H. K. Steinfeld
V. D. Wissmiller

4.2 MARINE REFRIGERATION AND AIR CONDITIONING
Chairman: L. L. Westling
S. W. Brown
H. M. Hendrickson
H. E. Parker
James Scott
L. E. Starr

4.3 ULTRA-LOW TEMPERATURE SYSTEMS AND TEST CHAMBERS
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C. T. Ashby
P. H. Brandt
G. F. Clark
C. F. Conrad
Bernard Friedman
D. E. Kramer
N. R. Miller
H. E. Rex
H. P. Soumerai

4.4 AIR CYCLE REFRIGERATION
Chairman, L. G. Desmon

4.5 HOT WATER AND STEAM HEATING
Chairman: R. M. Stern
G. F. Carlson
R. C. Chewning
J. R. Carroll
G. E. Hanson
H. P. Kaulfuss
R. B. Luhnow, Jr.
E. M. Mittendorff
J. D. Pierce
E. R. Teske

4.6 HEAT PUMP

Chairman: W. L. McGrath

E. R. Ambrose
Merl Baker
C. W. Cheatham
J. M. Cobb
C. J. Danowitz
S. F. Gilman
S. F. Graziano
G. C. Hall
C. W. Phillips
W. T. Smith
R. G. Werden

4.7 ELECTRIC HEATING

Chairman: G. G. Freyder

E. R. Ambrose
T. Baker
R. L. Boyd
L. R. Mast

Group 5—Heating and Refrigeration Loads—G. B. Priester, Coordinator

5.1 LOAD CALCULATION AND DESIGN CONDITIONS

Chairman: D. R. Lawrence

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D. L. Angus
Merl Baker
R. T. Baum
W. A. Biddle
J. V. Borry
R. B. Campbell
C. W. Coblentz
C. J. Danowitz
E. L. Galson
H. M. Hendrickson
W. G. Kane
T. C. Min
G. R. Munger
H. G. S. Murray
I. A. Naman
G. B. Priester
D. B. Turkington
F. H. Vann
A. G. Wilson
W. R. Yeary

5.2 THERMAL CIRCUIT ANALYSIS

5.3 FENESTRATION

Group 6—Environmental Control and Effects—John Clarke, Coordinator

6.1 PHYSIOLOGY AND HUMAN ENVIRONMENT

Chairman:

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E. F. Borgos
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A. W. Brant
R. E. Gould
A. J. Hess
F. K. Hick
J. S. Palmer
M. A. Ramsey
P. W. Wyckoff
R. G. Yeck

6.2 ACOUSTICS AND VIBRATION CONTROL

Chairman: R. E. Parker

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H. C. Hardy
C. A. Hathaway
F. B. Holgate
R. D. Lemmerman
A. W. Schach
Z. D. Squillace
R. J. Wells

6.3 ODOR CAUSES AND CONTROL

6.4 INDUSTRIAL ENVIRONMENT

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F. N. Calhoon
R. L. Graham
Robert Greenwald
E. C. Hungate
J. M. Kane
H. P. Kaulfuss
C. H. Pesterfield
George Walden, Jr.
R. M. Warren, Jr.
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6.5 PLANT AND ANIMAL HUSBANDRY

Chairman: R. E. Stewart

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T. E. Bond
M. K. Fahnestock
R. L. Givens
G. R. Nelson
H. J. Thompson
R. G. Yeck

Group 7—Unitary Equipment—L. K. Warrick, Coordinator

7.1 COMMERCIAL FOOD STORAGE AND DISPENSING EQUIPMENT

Chairman: J. H. Rainwater

R. D. Bartlett
D. E. Friedman
L. J. Gibbas
J. R. Haynes
G. W. Mathis
A. Perez
M. H. Strang

7.2 DOMESTIC REFRIGERATORS AND UNIT FOOD FREEZERS

Chairman: P. E. Davey

R. S. Buchanan
H. Deuker
R. L. Eichhorn
W. R. Johnson
Hershel Powell
R. Roider
H. A. Whitesel

7.3 TRUCK AND RAILWAY CAR REFRIGERATION UNITS

Chairman: G. A. Gallagher

G. E. Anderson
M. B. Green
Paul Jung
H. O. Kirkpatrick
C. W. Phillips
W. H. Redit
James Whalen

7.4 DRINKING WATER AND BEVERAGE COOLERS

Chairman: E. W. Scott

L. J. Anderson
W. M. Barnes
F. O. Graham
K. J. Helsing
P. R. Lynn
M. A. Porter
A. L. Rankin, Jr.
William Taylor
A. A. Zollo

7.5 ICE MAKERS

Chairman: D. E. MacLeod

Byron Booher
Crosby Field
A. G. Larson
B. D. Maseritz
Glenn Muffly

7.6 AIR CONDITIONERS AND DEHUMIDIFIERS

Chairman: B. J. Homkes

G. L. Biehn
T. G. Crider
William Hood
R. W. Kelto
H. R. Krueger
F. W. Osborn
D. L. Pitman
W. T. Rouse
L. J. Sahs
L. L. Smith
E. C. Tanner
R. G. Werden
P. W. Wyckoff

7.7 RAILWAY AND VEHICLE AIR CONDITIONING

Chairman: J. M. Strauss

D. C. Albright
J. V. Dobbs
J. D. Loveley
C. W. McElroy
Meyer Sutton
J. J. Wertheimer

7.8 MILK COOLERS

Chairman: R. L. Latzko

Darrell Evans
C. V. Haverly, Jr.
R. E. Steinhorst
D. F. Swanson
T. L. Tyler

Group 8—Products and Processes—E. J. Robertson, Coordinator

8.1 MEAT AND FISH PRODUCTS

Chairman: K. E. Nielsen

Paul Borders
Norman Breibe
E. N. Johnson
L. E. Joslin
C. D. Macy
W. C. Matthews
D. S. MacKenzie
W. H. Mavity
J. P. McShane
H. D. Tefft
F. P. Neff
R. W. Ranson
Roland Retrum
K. E. Wolcott

8.2 DAIRY, POULTRY AND ALLIED PRODUCTS

Chairman: E. N. Kerrigan

T. Y. Davis
L. J. Gibbas
J. Kronholz

8.3 FERMENTATION PROCESSES AND ALLIED PRODUCTS

Chairman: B. H. Bishop

W. E. Helin
M. J. Mayer
Fred Ophuls
C. M. Sieben
Charles Torry

8.4 CONCENTRATION, DEHYDRATION, AND OTHER FOOD PRESERVATION PROCESSES

Chairman: D. K. Tressler

D. C. McCoy
J. G. Woodroof

8.5 AGRICULTURAL PRODUCTS

Chairman: D. H. Dewey

C. A. Anderson
S. E. Mapes
W. E. Martin
C. Matthiesen
A. J. Monta

8.6 FROZEN FOODS

Chairman: C. F. Evers

Edgar Dickson
H. C. Diehl
W. H. Redit
M. F. Tokach

8.7 ICE MAKING, SKATING RINKS, AND INDUSTRIAL REFRIGERATION

Chairman: W. O. Kline

E. A. Johnson
F. W. Knowles
R. A. Stencel
Herman Vetter
O. B. Wert
C. L. Whitaker

8.8 COLD STORAGE WAREHOUSES AND LOCKER PLANTS

Chairman: G. A. M. Anderson

H. C. Brown, Jr.
B. B. Green
O. K. Irvine
W. E. Martin
E. K. Strahan
R. M. Stern
R. H. Trinkle

ASHRAE Research and T

Annual Report for the

The Research and Technical Committee, under the Society By-laws, directs all research and technical committee activities and, consequently, its report for the first full year of operation should be of interest to the whole Society membership.

The extensive organizational planning carried out during the past year is reported in detail. Information is also given about research currently under way at the Laboratory and in cooperating institutions.

R. C. JORDAN
Chairman (1959-60)
Research and Technical Committee

This report covers the activities of the Research and Technical Committee and of the Research Laboratory during the first full fiscal year of the merged Society for the period from July 1, 1959, to June 30, 1960. The Research and Technical Committee was 12 in number, consisting of:

R. C. Jordan, Chairman
E. P. Palmatier, Vice Chairman
H. C. Diehl
D. D'Eustachio
S. F. Gilman
F. K. Hick
N. B. Hutcheon
W. T. Pentzer
E. F. Snyder, Jr.
R. M. Stern
W. F. Stoecker
E. R. Wolfert

In addition the Executive Committee consisted of the following members:

R. C. Jordan, Chairman
E. P. Palmatier, Vice Chairman
N. B. Hutcheon
W. T. Pentzer
E. F. Snyder, Jr.
R. C. Cross, Executive Secretary – Ex-officio
B. H. Jennings, Director of Research – Ex-officio

Meetings of the full Committee were held October 27, 1959, January 31, 1960, and March 17, 1960, while meetings of the Research and Technical Executive Committee were held September 22, 1959, January 30, 1960, and March 16, 1960.

One of the important activities during the year was that of completely delineating the Committee patterns and activities with the following Committees and Committee Groupings applying:

RAC on Energy Conversion
RAC on Energy Transfer
RAC on Environment
RAC on Mass Transfer
RAC on Materials
RAC on System Analysis

In addition to the Research Advisory Committees, a number of Research Panels reporting to either a RAC or to the Research and Technical Committee itself were appointed. These are:

RP on Hydronics
RP on Odors
RP on Physiological Research and Human Comfort
RP on Sound and Vibration Control
RP on Thermal Circuits
Panel on Food Refrigeration and Food Technology
Panel on Psychrometry and Psychrometric Charts
Panel on Refrigerant Properties

These Panels deal basically with specific research activities of the Society relative to projects either currently activated or in the planning stages.

For the Technical Committees, eight groups have been constituted and organized with the individual Technical Committees reporting to the coordinator established for each group. These are:

1. Basic Theory and Materials – G. S. McCloy, coordinator
   13 Technical Committees
2. Basic Equipment – H. Soumerai, coordinator
   8 Technical Committees
3. Auxiliary Equipment – V. D. Wissmiller, coordinator
   4 Technical Committees
4. Systems – S. W. Brown, coordinator
   7 Technical Committees
5. Heating and Refrigeration Loads – H. T. Gilkey, coordinator
   3 Technical Committees
6. Environmental Control and Effects – John H. Clarke, coordinator
   4 Technical Committees
7. Unitary Equipment – L. K. Warrick, coordinator
   8 Technical Committees
8. Products and Processes – E. J. Robertson, coordinator
   8 Technical Committees

The names of all Committee members are published on pages 67-69 of this issue. Practically all of the Committees are now fully organized and functioning effectively. These Technical Committees perform their most extensive function in connection with the publication activities of the Society.

An Operational Guide outlining the organization, activities, and re-

Technical Committee

the 1959-60 year

B. H. Jennings
Director of Research

sponsibilities of the R and T Committee was prepared by a committee under the Chairmanship of E. F. Snyder, Jr. Preliminary drafts have been completed and it is expected that this can be released before the end of 1960.

Research Laboratory of ASHRAE in Cleveland

LABORATORY RESEARCH

Environmental Studies—The environmental program has represented by far the major activity of the Laboratory. The new environmental facility, completed in 1958, is now in full use. This consists of a complete structure for housing the environmental research facilities, constructed completely inside of the main Laboratory. The working chamber in which subjective impressions are obtained consists of a room 24½ ft long, 12 ft wide, with a ceiling height which can be varied from 5 to 12 ft. The temperature of each wall can be controlled separately and independently of the temperature and humidity conditions maintained by the air circulation system. This arrangement makes it possible to study the effect of a large number of varying radiation patterns.

One of the important usages to which this room is currently being put concerns the collection of data which will lead ultimately to a complete re-evaluation of the comfort region in relation not only to temperature and humidity but to radiation, air motion, degree of activity and effects of clothing. In addition, serious study is being given to developing reliable research techniques whereby the effect of pleasant and unpleasant environmental conditions related to productivity and learning rates can be investigated.

Two papers have resulted from research activities in the new Environmental Laboratories. The first, published January 1959, was "Environment Reactions in the 80 to 105 F Zone" and dealt entirely with subjective responses on the warm to hot fringe area completely outside of the comfort zone. The second paper published in February 1960, "Sensation Responses to Temperature and Humidity under Still Air Conditions in the Comfort Range" reported on investigations carried out specifically in the basic comfort region but related only to seated subjects under inactive conditions after they had reached equilibrium with space conditions.

Both of these papers have contributed specific information relative to subjective responses under specified conditions. It is clear that many additional studies of this type will have to be made before the complete pattern of the human in relation to his environment is known. At the present time the Laboratory is working on two projects, the first of which deals with evaluations of subjective responses under uniform, radiant environmental conditions. The second deals with the response of subjects to various ion levels. In the latter, high concentrations of ions, both positive and negative, have been investigated using, what is believed were, normal (healthy) subjects.

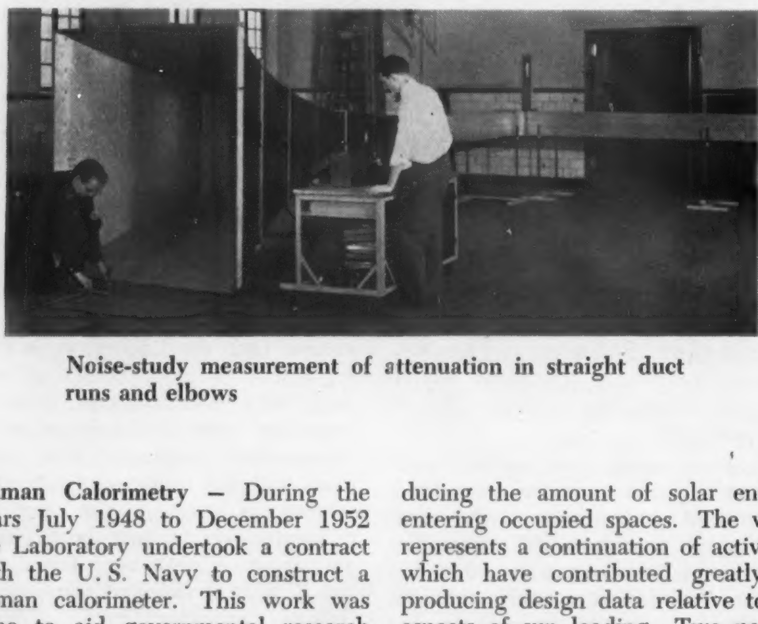
Plans are under way to intensify the environmental studies, so that they can be carried out at an even more vigorous pace than at present.

Odor Program — During the year studies in the field of odors have been actively under way. These have been carried out in the two odor test rooms at the Laboratory. With the help of subject juries to evaluate odor levels, the effectiveness of different types of agents in reducing odor levels has been explored. For example, activated carbon is one of the odor control methods investigated.

In addition, the effect of mask-

ing and counteracting agents has been studied, and a program using ozone has been carried through even though the toxicity of this substance was clearly recognized. Sufficient data have already been collected, so that a paper, now in preparation, will be available for the Semiannual Meeting in 1961.

Noise and Vibration – Studies in the Laboratory have dealt with the flow of air in ducts with consideration being given to the effect of vaned elbows, both in generating and attenuating noise, and with some consideration being given to the aspect ratio and size of the ducts themselves. The results of a large portion of this work were presented in "Attenuation and Generation of Sound in Elbows with Turning Vanes" by W. F. Kerka. The work at the Laboratory has been supported by a government contract with the Bureau of Ships of the U. S. Navy. The results of the work, however, are of broad interest not only to the Navy but to our membership.



Noise-study measurement of attenuation in straight duct runs and elbows

Human Calorimetry – During the years July 1948 to December 1952 the Laboratory undertook a contract with the U. S. Navy to construct a human calorimeter. This work was done to aid governmental research efforts, and also because it was realized that an instrument of this type could be employed to produce knowledge of great value to our understanding of human reactions to environment, particularly under stressed conditions. In fact when the calorimeter was completed one of the Laboratory engineers, Richard G. Huebscher, was granted a leave-of-absence in order to work with the medical staff at the National Naval Medical Center of the Naval Medical Research Institute in Bethesda.

Recently some of the results obtained on the calorimeter have obtained wide publicity, not only in regard to a knowledge of probable performance of subjects in space, but also through a basic paper by Dr. T. H. Benzinger which concludes that the control of thermal regulation of the body occurs in the hypothalamus center of the brain. Results from this calorimeter were so successful that the Navy again contracted with the Laboratory to develop modifications and improvements which would make the instrument even more flexible, and work in this connection was under way during the whole year.

Because of the knowledge available on the part of the Laboratory staff, a request was made by the University of Missouri to carry out part of the design and construction of a small animal calorimeter. As this appeared to be feasible this work was also undertaken and is now in progress under the direction of R. G. Huebscher.

Solar Studies – Over the past year studies have dealt with the problems related to shading or otherwise reducing the amount of solar energy entering occupied spaces. The work represents a continuation of activities which have contributed greatly to producing design data relative to all aspects of sun loading. Two papers have been completed, "Solar Heat Gain Factors for Windows with Drapes" by Necati Ozisik and L. F. Schutrum, presented at the Semiannual Meeting in February 1960, and by the same authors, "Solar Heat Gain through Slat-Type Between-Glass Shading Devices" presented at the Annual Meeting in June 1960. Work currently in the final stages involving the solar calorimeter is concerned with a study of the performance of plastics domes, and a study of the characteristics of coated glasses.

Infiltration Studies – During the year most of the experimental work relative to exploring all aspects of building infiltration as it relates to revolving doors installed in buildings was completed. A paper reporting on this work is in preparation. In order to obtain the required data, the research was set up to use an inert tracer-gas technique. However, because of the unavailability of helium in sufficient amounts, hydrogen was employed after making proper precautions to avoid reaching explosive concentrations.

Odor-test study, showing cigarette smoking machine and other equipment in enamel surfaced test room

Steam Flow Studies – The first paper resulting from this program was presented in February 1960 as "Flow of Saturated Steam in Copper Tubing" by C. M. Humphreys, J. T. Baker, and B. H. Jennings. In addition, an analytical paper on pipe sizing, "Re-evaluation of Steam Pipe Size Tables for the ASHRAE GUIDE" by W. F. Kerka was presented at the same meeting. Work currently is being completed relative to determining the conditions which apply when steam and water are in counter flow. A number of hitherto unreported facts have been brought to light, particularly in regard to the carry-over characteristics of the water associated with steam. Extensive use has been made of glass tubing in order to visually make possible proper interpretation of the data obtained.

Environmental Control – The comfort and welfare of occupants in controlled space is an important aspect of environment. However, before the response of occupants relative to the space can be completely comprehended, a better understanding of the action of components which condition and control the space must also be available. This aspect involves an analysis of dynamic characteristics.

The RAC on System Analysis and a predecessor Committee on Con-

trol have been planning a study which will endeavor to obtain answers to such questions insofar as the controlled environment relates to components of the system such as coils, flow rates of air and other fluids, system geometry, distribution, type of control action, and other factors.

Although no research work has been done as yet, a small flexible laboratory for measuring variables of the type indicated has been almost completed. This Laboratory is also equipped with facilities for investigating problems associated with high-intensity illumination as this concerns heat generation and response to glare.

Oustide the environmental test rooms, showing control equipment and data center

General – In planning for the coming fiscal year, the Committee committed itself to emphasis at the Laboratory on aspects of the environment as related to humans. This will be evidenced by an expansion of activity of the environmental programs already under way.

Cooperative Research – Projects are under way at a number of institutions. The institution, title of the project, and a brief report of progress follows.

University of Arizona – Study of Noise in Liquid Flow Systems. This project is under the direction of Dr. W. L. Rogers and is a continuation of work that he started at Northwestern University. During the current year the activity has been focused on determining how the natural frequencies of piping spans can create or intensify noise problems. Attention is also being focused on the study of resonance in the liquid path. This topic will be explored in detail during the summer and fall of 1960. The Research Panel on Hydronics has been following this work quite closely.

University of California – At this institution two projects are under way: Development of Thermal Circuit Instrumentation for Use in Air-Conditioning Problems and Application of Analogue Techniques to Solar Energy Collectors. Both of these have been under the direct supervision of Professor Harry Buchberg who already has written and presented two papers in this general field before the Society.

Case Institute of Technology – Model Studies in Air Distribution. This project is under the direction of Professor G. L. Tuve, who has been carrying out a careful study of the patterns of air distribution and its movement through spaces, with the work being done in a model-size room where accurate controls can be maintained. The results from these studies, by suitable analysis, can be referred to conventional-sized spaces.

The second study at the Institute is entitled, Heat and Mass Transfer in Dehumidifying Processes. This project is under the direction of Professor W. L. Bryan, and much significant data have been gathered during the current year. More experimental work, however, is needed before a paper reporting on the project can be expected.

Kansas State University – One project here is entitled Heat Transfer from Air Conditioning Ducts. In this, temperature drops in air distribution ducts with velocities as high as 5,000 ft per minute are being measured. It is believed that work will be advanced sufficiently far during the next year to yield a paper on the subject. The work is being done by Professor R. G. Nevins with the help of A. C. Kent and R. H. Mo.

A second investigation is entitled Heat Transfer of Condensing Freon in Horizontal and Inclined Tubes. Work on this project is nearly completed, and analyses of the data indicate that a better insight to the heat transfer problem can be gained by investigating local rather than average film coefficients. This work is being conducted by Professor Nevins with the help of Dr. N. Z. Azer, Professor J. E. Kipp, and Mr. Bong Koh.

University of Kentucky – The project on the Influence of Bubbling and Rotational Turbulence on the Rate of Boiling from a Small Cylinder Immersed in a Liquid Refrigerant has been continuing throughout the year under the direction of Dr. Merl Baker and Mr. James E. Bocock.

University of Minnesota – The project at the University of Minnesota concerns the Effectiveness and Design of Solar Heat Collectors. This work has sought to clarify the prediction of solar radiation availability not only on cloudless, but in all types of solar environments. Work has also been done involving the use of secondary reflectors. It is felt that on completion of the program the information presented will make extensive solar collector tests unnecessary in order to predict performance. This work is under the direction of Professor R. C. Jordan.

Pennsylvania State University – The project on Sterilization of Air by Solid Sorption Dehumidifiers has been completed and presented in a comprehensive unpublished report. Professor E. R. McLaughlin is in process of condensing this to constitute a Society paper for presentation at the coming Semiannual Meeting.

University of Pittsburgh – At this institution, the study Lateral Exhaust Ventilation has been under way for several years, under the guidance of Professor T. F. Hatch. It is believed that his final paper on this project will become available during the 1960-61 year.

University of Toledo – Sterilization of Air by Liquid Sorbents. The basic research in this investigation is finished. However, before publishing the paper Dean Archie Solberg felt it

Contributors to the ASHRAE Research Program

During the Fiscal Year, 1959-60

Adams, Inc., Henry
Aerco Corporation
Aerofin Corporation
Alco Valve Company
Aluminum Company of America (Alcoa Research Labs.)
American-Saint Gobain Corporation
Anderson Company, W. M.
Anemostat Corporation of America
Armstrong Cork Company
Arrow-Hart & Hegeman Electric Company
Austin Company
Auto-Flo Corporation
AVCO Mfg. Corporation, Lycoming Heater Div.

Barber-Colman Company
Barnebey-Cheney Company
Beck Company, Henry C.
Bell & Gossett Company
Bohn Aluminum & Brass Corporation
Bouillon, Griffith, Christofferson & Schairer
Bridgers and Paxton Consulting Engineers, Inc.
Brookside Corporation
Buensod-Stacey Inc.
Buffalo Forge Company
Burgess-Manning Company, Architectural Products Div.
Burnham Corporation

Cambridge Filter Manufacturing Corporation
Carnes Corporation
Carrier Corporation
Century Electric Company
Chapman, W. P.
Clarage Fan Company
Cleveland Electric Illuminating Company
Cosentini Associates

Davis Supply Company, C. W.
DeBra Company, Fred B.
Detroit Edison Company
Dow Chemical Company
Dunham-Bush, Inc.
duPont de Nemours & Company Inc., E. I.

Feldman & Sons, Inc., Phil
Flint Refrigeration
Forslund Pump and Machinery Corporation
Frigidaire, Div. of General Motors

G & O Manufacturing Company
Garden City Fan Company
Gibson Refrigerator Company, Div. of Hupp Corporation
Gustin-Bacon Manufacturing Company

Halstead & Mitchell
Hastings Air Conditioning Company
Heating, Piping & Air Conditioning Contractors—Madison Association
Henry Valve Company
Hoffman Specialty Mfg. Corporation
Hydrotherm, Inc.

Ilg Electric Ventilating Company
Inland Steel Products Company
Insulation Board Institute
Iron Fireman Manufacturing Company

Janitrol Heating and Air Conditioning, Div. of Midland-Ross Corporation
Jaros, Baum & Bolles
Jenkins Bros.
Jenn Air Products Company, Inc.
Johns-Manville Corporation
Jordan, R. C.

Kahn Associated Architects and Engineers Foundation, Albert
Owens-Illinois Glass Company (Kimble Glass Company)
Koch Refrigerators, Inc.
Koppers Company, Inc.
Korfund Company
Kramer Trenton Company
Kroeker and Associates, J. Donald

Lau Blower Company
Lennox Industries, Inc.
Leopold Incorporated, Charles S.
Leslie Company
Libbey-Owens-Ford Glass Company
Lockport Mills, Inc.

McCord Corporation
McDonnell & Miller, Inc.
McFarlan Company, Inc., A. I.
McQuay, Inc.
Marley Company
Mechanical Contractors Association of Cleveland
Mechanical Contractors Association of Memphis
Mechanical Contractors Association of Philadelphia, Inc.
Mechanical Contractors Chicago Association
Metals & Controls, Div. of Texas Instruments Inc.
Minneapolis-Honeywell Regulator Company
Mississippi Glass Company
Modine Manufacturing Company
Monsanto Chemical Company
Morrison Products, Inc.
Morrison Supply Company

National Mineral Wool Association
Nesbitt, Inc., John J.

Orr-Schelen, Inc.

Paragon Electric Company
Penn Controls, Inc.
Philadelphia Electric Company
Pittsburgh Plate Glass Company
Powers Regulator Company
Propellair, Div. of Robbins & Myers, Inc.

Radex Corporation
Raisler Corporation
Ranco, Inc.
Recold Corporation
Reflectal Corporation, Sub. of Borg-Warner Corporation
Revcor, Inc.
Reznor Manufacturing Company
Roberts-Gordon Appliance Corporation
Robertshaw-Fulton Controls Company, Fulton Sylphon Div.
Rockwell, Theo. F.
Rohm & Haas Company

Schemenauer Mfg. Corporation
Scovill Mfg. Company
Sears & Kopf
Simons, Joseph
Smith Company, Inc., H. B.
Spence Engineering Company, Inc.
Spoehrer, H. F.
Sporlan Valve Company
Stinard, Rutherford L.
Structural Glass Company
Surface Combustion Corporation

Technical Filter Company
Torrington Manufacturing Company
Trane Company
Typhoon Air Conditioning Company, Div. of Hupp Corporation

United Sheet Metal Company, Inc.

Voorhees Walker Smith Smith & Haines

Webster & Company, Warren
Wehmeyer, Mark O.
Weil-McLain Company
Weil Pump Company
Weiss & Company, Carl
Welbilt Corporation
Whirlpool Corporation
White-Rodgers Electric Company
Whitman, Requardt and Associates
Whittlesey and Associates
Wiremold Company

York Division, Borg-Warner Corporation

Zonolite Company

desirable to correlate his results with the performance of other liquid sorbent units installed in other locations. This has now been done, and with the good correlation obtained the paper can be expected momentarily.

Finances and Expenditures—The auditor's report for the fiscal year ending June 30, 1960, has not yet been received. Preliminary figures indicate that total expenditures for research during the fiscal year totaled \$212,600. This was a lesser amount than was expended in previous years and represented a cutback in funds in conformity with the pattern of expense reduction that the whole Society put into operation.

The Society is grateful to the many companies, individuals and organizations which indicated their confidence in the Research Program by generous contributions to the Program. It is gratifying to know that both the number of contributors and the total contributions were greater than for the preceding fiscal year. The Research and Technical Committee and the officers of the Society appreciate this support and take pleasure in listing, as part of the report, the honored names of all those in this category.

In the spring of 1960, under the direction of a Fund Raising Committee consisting of John E. Dube, Chairman, Albert Giannini, S. F. Gilman, and J. W. May, an intensive program of fund solicitation was started. This in turn was preceded by obtaining the services of T. R. Jordan who prepared a number of news releases designed to make the Research Program better known both

to the general public and to the engineering profession. It will not be possible to evaluate the long-range effect of these programs for some time.

Facilities and Staff – There are now eight members of the Laboratory staff at the professional level and eleven members at the supporting level. This represents a reduction in staff over the preceding year carried out for budgetary reasons. In addition to the permanent staff a number of environmental subjects ranging from six to fourteen have been used intermittently throughout the year.

The Laboratory is pleased to have on its staff a visiting member from Heidelberg, Germany, Günter Seltmann, Dipl. Ing., who is working at the Laboratory on a NATO fellowship to obtain a background in American research methods and at the same time to learn of American practices in the air-conditioning, heating, and refrigeration industries.

Candidates for ASHRAE Membership

Following is a list of 82 candidates for membership or advancement in membership grade. Members are requested to assume their full share of responsibility in the acceptance of these candidates for membership by advising the Executive Secretary on or before September 30, 1960 of any whose eligibility for membership is questioned. Unless such objection is made these candidates will be voted by the Board of Directors.

Note: * Advancement † Reinstatement

REGION I

New Jersey

HACKL, A. J.,* Gen. Mgr. A-C Div., Worthington Corp., East Orange.
KEGEL, R. A.,* Appl. Engr., Worthington Corp., East Orange.
KULLAY, EMERY, Chief Htg. Vtg. A-C Engr., Theodore J. Kauffeld, Newark.

New York

BRESSMAN, JOSEPH, Cons. Eng., New York.
CANSDALE, J. H., Asst. Secy., American Society of Heating, Refrigerating and Air Conditioning Engineers, New York.
DAVIS, R. A., Br. Mgr., Powers Regulator Co., Buffalo.
FRENCH, D. E., Charge of design of individual proj., Mech. & Structural Fields, Sargent-Webster-Crenshaw & Folley, Syracuse.
HAMBLEN, H. C., Special Sales Engr., American Air Filter Co., New York.
JENKINS, A. W., Sr. Sales Engr., Esso Standard, Div. Humble Oil & Refining, New York.
KENNEDY, S. E., Engr., New York Telephone Co., New York.
KHANNA, K. C., Mech. Designer, Voorhees Walker Smith Smith & Haines, New York.
LUTHER, D. H., Sales Engr., Trainee, Buffalo Forge Co., Buffalo.
MCGRAW, J. T. JR., Design Sales, Appl. Eng., R. J. Murray Co. Inc., Schenectady.
QUEENIN, M. A.,† Mech. Supt., Proj. Mgr., Jas-King & Son, Inc., New York.
REESE, R. C., Proj. Engr., Corning Glass Works, Corning, N. Y.
SANDBERG, C. I., Mech. Engr., U. S. Public Health Service, New York.
SIMPSON, B. R.,* Refr., A-C Maint., Bausch & Lomb, Inc., Rochester.

REGION II

Canada

CLEMANN, MARK, Designer, Adjeleian Goodkey Weedmark, Ottawa, Ont.
KERRISON, C. M., Tech. Sales Fans, Woods of Colchester (Canada) Ltd. Leaside, Toronto, Ont.
SMYLIE, J. C., Jr. Asst. Mech., Toronto Board of Education, Toronto, Ont.

REGION III

District of Columbia

DILLARD, R. J., District Engr., York Corp., Washington.
LYLES, B. A.,* Lieutenant, U. S. Army, Washington.

Maryland

CAVEY, E. K.,* Mech. Estimator & Field Supvsg., Riggs Distler & Co., Baltimore.
KARAYINOPULOS, JAMES, Estimating & Sales, Better Air Products, Baltimore.

Pennsylvania

GOODRIDGE, WILLIAM,* Mfg. Agent, Pittsburgh.

REGION IV

Florida

APPARICIO, I. G., Electrician, Suwannee S. S. Co., Jacksonville.
KUHL, V. W., JR., Chief Mech. & Electrical Engr., Pullara & Watson, Tampa.
LINGO, C. K.,† Com. Mgr., (Sales Engr.,) Florida Power & Light Co., Miami Beach.
TURNEY, J. C., Sales Engr. & Estimator, Joe M. Bowlby Co., Tampa.

Georgia

LLOYD, R. T., JR.,* Sales Engr., York Corp., Atlanta.
WHITE, E. F.,* Mech. Engr., Corp. of Engineers, Savannah.

North Carolina

THACKSTON, P. L.,* Engr., Bahnson Co., Winston-Salem.

REGION V

Indiana

SIGMAN, W. A.,* Sales Engr., Johnson Service Co., Indianapolis.

Ohio

CRAWFORD, R. W., Br. Mgr., Slawson Equipment Co., Inc., Youngstown.
MAGUIRE, W. G., Mech. Engr., A. M. Kinney, Inc., Cincinnati.
NORTON, J. P.,* Dvlpt. Engr., Armstrong Furnace Co., Columbus.

REGION VI

Illinois

CHEW, R. T., Proj. Engr., Keeney Research, Div., J. H. Keeney & Co., Chicago.
MORE, V. D.,* Mech. Engr., Abbott Laboratories, North Chicago.
OLBUR, H. M., Chief Engr., Arrowhead Heating & Cooling, Chicago.
VIRDI, B. S.,* Asst. Engineer "A," Allis Chalmers Mfg. Co., Harvey.

Michigan

GATCHELL, G. M., Pres., Gatchell & Burwell, Inc., Detroit.
GRIFFITHS, J. L., JR., Sales Engr., American-Standard, Industrial Div., Detroit.

Minnesota

WORKINGER, G. G., Vice-Pres., Sales, McQuay, Inc., Minneapolis.

Wisconsin

ALEITHE, H. K., Sales Engr., Milwaukee Gas Light Co., Milwaukee.

REGION VII

Kentucky

ROBERTS, C. J., JR., Sales Engr., Trane Co., Louisville.

Missouri

DEPUNG, ELMER, JR., Supvsr., Gas Service Co., Kansas City.

Tennessee

GIESLER, G. H., Mfg. Agent, Knoxville.

REGION VIII

Oklahoma

LOCKWOOD, G. E.,* Mech. Engr., Wm. J. Collins, Jr., Oklahoma City.

Texas

BROWN, M. L., JR.,† Field Engr., Dacco Supply Co., Dallas.
KOCHHAR, VIMAL,* Refr. Engr., Friedrich Refrigerators Inc., San Antonio.
POWELL, M. E.,* Engr., Carrier Corp., Dallas.
SIMON, H. L., Sales Repr., Trane Co., San Antonio.

(Continued on page 98)

Meetings ahead

October 10-12 – American Gas Association, Annual Convention, Atlantic City, N. J.

October 20-23–Refrigeration Service Engineers Society, Annual Convention, Portland, Ore.

October 25-27 – American Standards Association, 11th National Conference on Standards, New York, N.Y.

October 28-November 2 – Air Conditioning and Refrigeration Wholesalers, Silver Anniversary Convention, SS Hanseatic.

October 29-November 4–Oil Heat Institute, Diamond Jubilee Cruise and Management Conference, HMS Queen of Bermuda.

October 31-November 3 – Institute of Boiler and Radiator Manufacturers, Semiannual Meeting, Absecon, N.J.

November 14-16–National Warm Air Heating and Air Conditioning Association, 47th Annual Meeting, Cleveland, Ohio.

November 15-17 – Building Research Institute, Fall Conferences, Washington, D. C.

November 18-22 – Air Conditioning and Refrigeration Institute, Annual Meeting, Hollywood Beach, Fla.

November 20-23 – Refrigeration and Air Conditioning Contractors Association, Annual Meeting, Miami, Fla.

November 27-December 2–American Society of Mechanical Engineers, Annual Meeting, New York, N. Y.

November 28-December 2–24th National Exposition of Power and Mechanical Engineering, New York, N. Y.

December 1-2 – National Association of Practical Refrigerating Engineers, Annual Meeting, St. Louis, Mo.

December 12-15–Industrial Building Exposition and Conference, New York, N. Y.

February 13-16–American Society of Heating, Refrigerating and Air Conditioning Engineers, Semiannual Meeting, Chicago, Ill.

February 13-16 – 15th International Heating and Air-Conditioning Exposition, Chicago, Ill.

People

Carl F. Kayan, Fellow of ASHRAE and the American Association for the Advancement of Science, and Professor of Mechanical Engineering, Columbia University, has been elected a Fellow of the American Society of Mechanical Engineers. With Columbia since 1925, he was recipient of the Society of Older Graduates' "Great Teacher Award" for 1959. Professor Kayan has made outstanding contributions in research in important areas of heat transfer, air conditioning and refrigeration. Author of more than 30 articles discussing heat transfer problems and 15 publications for the Refrigeration Research Foundation, he presented papers, in his capacity as United States Delegate to the International Institute of Refrigeration, in Moscow and Prague. In 1955 he was Visiting Professor at the Royal Institute of Technology in Sweden. Papers were presented by him at the 9th International Congress of Applied Mechanics in Brussels, and he was the U. S. observer at the Louvain and Zurich meetings of the International Institut du Froid in 1956. Acknowledged as a pioneer in the electric simulation of energy flow, and a recognized authority in this field, he has delivered a series of lectures under the auspices of the Advisory Group for Aeronautical Research and Development under NATO in Holland, Germany, Italy and Norway. He has represented the Engineers' Joint Council as Committee Chairman on the recognition of specialties in engineering and has been active in promoting national relations in technical and engineering fields. Elected honorary Vice President of the John Ericsson Society of New York, Professor Kayan is a founder and past-President of the Instrument Society of America; President of the Commission on Heat Transfer, Insulation and Instrumentation of the International Institute of Refrigeration; and member of the Air Pollution Control Board of New York and the New York Academy of Science.

Roy L. Stephens, past-President of the Panama and Canal Zone Special Branch, ASHRAE, has retired from the position of Chief Mechanical Engineer, U. S. Army Caribbean. A member of the former ASRE since 1936, he was active in the Philadelphia and Baltimore-Washington Sections, and was also a member of ASHAE.

Charles M. Heathman has been named East-Central U. S. Regional Sales Manager by Copeland Refrigeration Corporation. Since 1958, he has been a partner in the Heathman-Clark refrigeration sales and service firm. He was associated formerly with Brunner Manufacturing as National Service Manager and the Servel Company in various sales, service, engineering and production capacities. Connected with the refrigeration industry since 1935, he is a member of ASHRAE and Refrigeration Service Engineers Society.

Dewitt M. Allen, head of D. M. Allen Company, has been named Kansas City representative for General Blower Company. Former President and council member of the Kansas City Chapter of ASHAE, he has been engaged in engineering and selling of heating and ventilating equipment for the past 39 years.

William L. McGrath, holder of more than 100 patents in the air conditioning field, has been appointed General Manager of the Unitary Equipment Operation of Carrier Corporation. Prior to assuming his new post he served as Chief Engineer of the former Unitary Equipment Div. He will be in charge of activities relating to design, production and sale of self-contained air conditioning products.

Hugo C. Smith, as newly-appointed Sales Representative for Bohn Aluminum & Brass Corporation commercial refrigeration products and unitary coils, will be responsible for Ohio, western Pennsylvania and West Virginia, and Garrett and Allegheny Counties in Maryland. Active in the industry for more than 30 years, he has served with such organizations as Frigidaire, Carrier Corporation, General Motors and Refrigeration Sales Corporation. He is well known for his writing of the Application Engineering Sect in "Refrigeration & Air Conditioning Business."

I. B. Secord, in his new capacity as National Sales Manager for Hi-Press Air Conditioning of America, will be in charge of the Commercial and Industrial Div. Coming to Hi-Press after five years as National Sales Manager and Sales and Application Engineer for Drayer-Hanson Div of National-U. S. Radiator Corporation, he has been active in air conditioning sales since his graduation from George Washington University in 1948.

Woodrow Wilson, Altoona Supervisor of Factory Engineering and Maintenance for SKF Industries, Inc., has been named Altoona Plant Manager. He joined the assembly dept of the Altoona div in 1952.

William Waeldner has been appointed Director of Research for Anemostat Corporation of America. An alumnus of the University of Notre Dame, he has held various positions with Anemostat since first joining the company in 1946 as a Research Engineer. He was appointed Assistant Director of Research in 1955.

David B. Farnum is now Michigan District Sales Manager for Welbilt Air Conditioning and Heating Corporation. Before joining Welbilt, he was a sales representative for Warren S. Farnum Company and salesman for Elliott Electric Company. He is a 1953 graduate of Indiana University.

Marvin K. Gardner has been appointed Sales Representative for General Blower Company, a subsidiary of Ilg Electric Ventilating Company, bringing to the organization more than 23 years of experience in heating, ventilating and air conditioning. Graduated from Southern Methodist University with a degree in mechanical engineering, he will continue to represent Ilg.

D. D. Williams has been appointed Southeastern Regional Sales Manager for Coolerator Div, McGraw-Edison Company, and will be responsible for sales in Virginia, North and South Carolina, Georgia, Alabama, Mississippi, Tennessee and Florida. He came to Coolerator as a Regional Manager in 1958, having been associated previously with Chrysler Air-Temp, Coleman and Frigidaire.

David J. Wood, Assistant Sales Manager in charge of distributor sales for Frick Company for the past two years, has been appointed Manager of Market Planning. A graduate of Fenn College, he has more than 20 years experience in refrigeration and air conditioning equipment sales.

Erwin L. Weber, Consulting Engineer of Seattle, Wash., and ASHRAE Life Member, has prepared five articles on heating and cooling for the forthcoming McGraw-Hill Encyclopedia of Science and Technology. His contributions included 400-word articles on hot water heating, radiators, radiant heating and panel heating and cooling and an 800-word article on solar heating. These articles were based upon experience gained in his fifty years as a consulting engineer. A native of Germany, he was graduated from the University of Minnesota in 1906 with a degree in electrical engineering, and from the same university in 1908 with a degree in mechanical engineering. He opened his office as a consulting engineer in 1910. Contributor to many technical magazines, he is well known for his work in hot water heating and panel heating and cooling systems. A pioneer in these fields, he also holds several patents.

George B. Baan, for 15 years with Standard Oil of New Jersey and affiliated companies, has joined Handy Associates, Inc., as Vice President of International Operations. In this capacity he will direct overseas services for both American and foreign companies, including market studies, organization planning and method surveys. With Jersey Standard he served as a marketing specialist, assisting world-wide operations. He was associated previously with International General Electric Company and Frigeco, and served as an industrial engineer for Hat Corporation, Bullard Machine Tool and American Time.

J. H. Jarrett becomes Sales Manager of the Refrigeration Products Div of Ansul Chemical Company. He joined Ansul in 1953 and in January of last year left his position as Refrigeration Sales Manager of the mid-continent region to become an assistant to the Vice President.

Others are saying—

that . . . . . . in order to provide more comfortable working conditions in a diesel engine testing plant, a "spot cooling" system for ventilating test cells was selected. Each cell is provided with four adjustable air outlets, located two to each side of the entrance. Each outlet discharges 500 cfm of air at 2500 fpm along each side of the engine being tested, the air stream entering in close proximity to the testing engineer, cooling him with moving air. Volume and temperature of the air can be adjusted to his comfort. An outlet grille in the ceiling allows air heated by the operating engine to escape, withdrawn by a ceiling exhaust fan. *Heating, Piping & Air Conditioning, July 1960, p 127.*

that . . . . . . additional insulation of existing houses in which there is a heating plant, in order to conserve fuel, usually results in the necessity of maintaining the boiler at a lower temperature in order to avoid excessive room temperatures. Drawbacks arise in spring and autumn, when the necessary boiler temperature becomes so low that hot domestic water is colder than is desirable. Increase of boiler temperature will necessitate frequent airing of the rooms to reduce room temperature with the ultimate result that this additional insulation does not bring about the desired saving on fuel. To remedy this, either a by-pass may be fitted to permit mixing of boiler water with

(*Continued on page* 94)

CORRECTION — The announcement in the August issue concerning the elevation of ASHRAE members Russell Gray and Charles V. Fenn to Executive Vice Presidencies of Carrier Corporation should have read:

"Concurrent with these elections, Mr. Fenn has also been elected a director of the Corporation, and Assistant to President William Bynum. Mr. Gray has been designated President of a newly organized division, Carrier Air Conditioning Company."

NEWS OF STANDARDS

A. T. BOGGS, III
ASHRAE Technical Secretary

American Standards—Copies of revised American Standards concerning pipe flanges and fittings are available from ASME. ASA B16.1-1960 covers cast iron pipe flanges and flanged fittings, Class 125. ASA B16.2-1960 covers these flanges and fittings for Class 250. Standards include information on pressure ratings, sizes and methods of designating openings of reducing fittings, marking, minimum requirements for materials, dimensions and tolerances, bolt, nut, and gasket data, and required tests. Copies are available at $1.50 each from the American Society of Mechanical Engineers, 29 West 39th Street, New York, N. Y.

Nema—The Transformer Section of Nema has announced a new publication which includes all of the present transformer standards. This publication is identified as "Nema Standards Publication—Transformers, Regulators and Reactors; No. Tr 1-1960." Copies are available from the National Electrical Manufacturers Association, 155 East 44th Street, New York 17, N. Y. at $1 per copy. The text of this publication includes information on transformer standards approved by ASA and those Nema transformer standards still awaiting ASA approval. The material is divided into 20 separate parts and includes general standards, test code, terminology and apparatus standards applicable to this class of electrical equipment.

NFPA—The National Fire Protection Association, 60 Batterymarch Street, Boston 10, Mass., has announced availability of NFPA Publication #409 "Aircraft Hangers." This publication covers new recom-

ASHRAE BOARD OF DIRECTORS RULE

Occasions may arise when individual members of the Society, or Society Chapters, are called upon to recommend or give opinions on proposed laws, regulations or ordinances relative to the heating, refrigerating, ventilating or air-conditioning industries. It is recognized that many members will want to and should participate in such legislation. It is the duty of all members, as *individuals*, to become interested in government affairs and to make available to their fellow citizens their best technical knowledge and experience.

The Society approves of such action when it is done by an individual, as such, but not when it is done by a Society Chapter which thereby, explicitly or implicitly, uses the name of the Society or of the Chapter to lend weight or prestige to their conclusions.

The Society has been granted tax exemption under present Section 501(c) (3) of the existing Internal Revenue Code. This exemption is granted only to organizations organized and operated exclusively for religious, charitable, scientific, educational, and other similar purposes. This exempts an organization such as the Society from income taxes, makes contributions to it deductible by the donors in computing their taxable net income, makes bequests and legacies to it deductible in computing the net taxable estate of the decedent for estate tax purposes, makes gifts to it deductible in computing taxable gifts for gift tax purposes, and, indirectly, is a basis for exemption by the Society from certain state and local taxes.

Under the Internal Revenue Code of 1954 Section 501 (c) (3) an organization is granted exemption provided no substantial part of its purposes or activities is carrying on propaganda, or otherwise attempting, to influence legislation, and provided the organization does not participate in, or intervene in (including the publishing or distribution of statements), any political campaign on behalf of any candidate for

mendations for fire safety and is a revision of the 1958 issue of provisions on the same subject. Copies are available at 75c each from NFPA headquarters.

Also available are tentative recommendations on controlling the fire problem of flammable liquid spills on airport ramps. These recommendations are included in NFPA Standards 415-T "Tentative Recommendations on Airport Drainage." Copies are available at 40c each from NFPA.

U. S. Government—A new List of Commercial Standards revised to July 1, 1960 is now available from the Commodity Standards Division, Office of Technical Services, U. S. Dept. of Commerce. Also available is a pamphlet "Commodity Standards, WHAT they are—HOW they are done—WHY they are used." Single copies of the list and the pamphlet are available without charge upon request to the Commodity Standards Division, U. S. Department of Commerce, Washington 25, D. C. (DUdley 6-1506) Ask for Catalog No. 978, and the current Commodity Standards Pamphlet.

The National Bureau of Standards has announced availability of a new monograph. This publication is Monograph 10, titled "1958 He4 Scale of Temperatures." Copies are available at 20c each from the Superintendent of Documents, Washington 25, D. C.

The Commodity Standards Division, Office of Technical Services, has announced availability of a new edition of the Commercial Standard for Warm Air Furnaces. The title of this publication is "Warm-Air Furnace-Burner Units Equipped with Pressure-Atomizing or Rotary-Type Oil Burners" CS195-60. The revised standard covers both gravity and forced-air furnaces having specified input ratings of 560,000 Btu hr or less. Copies may be obtained from the Superintendent of Documents at 15c each.

ULE OF THE BOARD RE LEGISLATIVE ACTIVITIES

public office. If the U. S. Treasury Department finds that an exempt corporation is violating the foregoing provisions it is empowered to cancel the organization's exemption.

The word "substantial" has never been clearly defined so it is impossible to determine whether any particular action or actions might be found by the Treasury Department to be substantial, and therefore improper, and result in cancellation of the tax exemption.

This board desires, therefore, to fix a policy which, in the opinion of our legal counsel, will be within the provisions of the law.

It is the opinion of this Board that any activity of the Society, or any of its Chapters, or any group of its members, acting in the name of the Society or any of its Chapters, to attempt to influence legislation might result in the loss of the Society's tax exempt status.

It is, however, the opinion of this Board that, when particular occasions arise for the Society, any of its Chapters, or a particular group of its members, to express opinions on proposed laws or regulations concerning the engineering arts and sciences with which this Society is concerned, the Society, the Chapter, or any group of members, may appoint one or more representatives to express, as *individuals*, his or their opinion regarding any proposed legislation. When an individual expresses his opinion on proposed legislation he may identify himself as a member of the Society but should make it clear that he is speaking only for himself as an individual and not as a representative of the Society, or Chapter, or any group of its members.

This statement of policy has been approved by this Board of Directors and constitutes an official directive and standing rule of this Board.

The above rule was formally voted upon affirmatively by the ASHRAE Board of Directors at its June 12, 1960 meeting in Vancouver, B. C.

We're Playing In The Big Leagues

... where teamwork counts

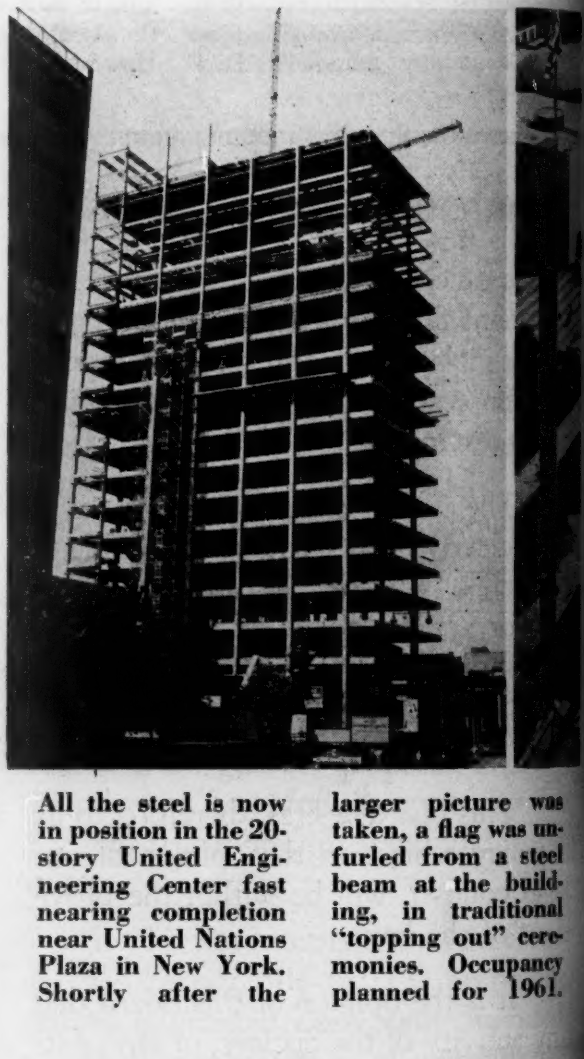
Good teamwork has helped speed up the construction of the United Engineering Center. On July 26, "topping out" ceremonies were held . . . a week ahead of schedule.

ASHRAE's pace in raising its contribution of $250,000 is disappointingly slow. YOUR Society is lagging far behind the others. To date, only 531 of our 17,500 members have contributed. Less than $25,000 has been raised.

This is YOUR opportunity to join with your fellow engineers in a united effort to build the world's largest single engineering center. YOUR CONTRIBUTION IS NEEDED IN MAINTAINING OUR BIG LEAGUE POSITION.

The Central Oklahoma Chapter has demonstrated its TEAMWORK and PROFESSIONAL PRIDE by not only reaching its quota but by exceeding it substantially.

NOW is the time for all members to dig down and GIVE. THIS IS YOUR HEADQUARTERS. SUPPORT IT!



All the steel is now in position in the 20-story United Engineering Center fast nearing completion near United Nations Plaza in New York. Shortly after the larger picture was taken, a flag was unfurled from a steel beam at the building, in traditional "topping out" ceremonies. Occupancy planned for 1961.

NAME ....

ADDRESS ....

IN CONSIDERATION OF THE GIFTS OF OTHERS INTENDS TO GIVE TO

UNITED ENGINEERING CENTER BUILDING FUND

..............................DOLLARS $........

BALANCE TO BE PAID QUARTERLY $........, SEMIANNUALLY $........

ANNUALLY $........, OR AS FOLLOWS ....

SIGNED..

MEMBER ASHRAE

CHECK MAY BE MADE PAYABLE TO UNITED ENGINEERING TRUSTEES, INC.
29 WEST 39TH STREET, NEW YORK 18, N. Y.
GIFTS ARE DEDUCTIBLE FOR INCOME TAX PURPOSES

For your convenience a contribution pledge form is incorporated within this page. Mail to ASHRAE, 62 Worth Street, New York 13, N. Y.

UEC FUND RAISING COMMITTEE
Merrill F. Blankin, *Chairman*
W. J. Collins, Jr., *Vice-Chairman*
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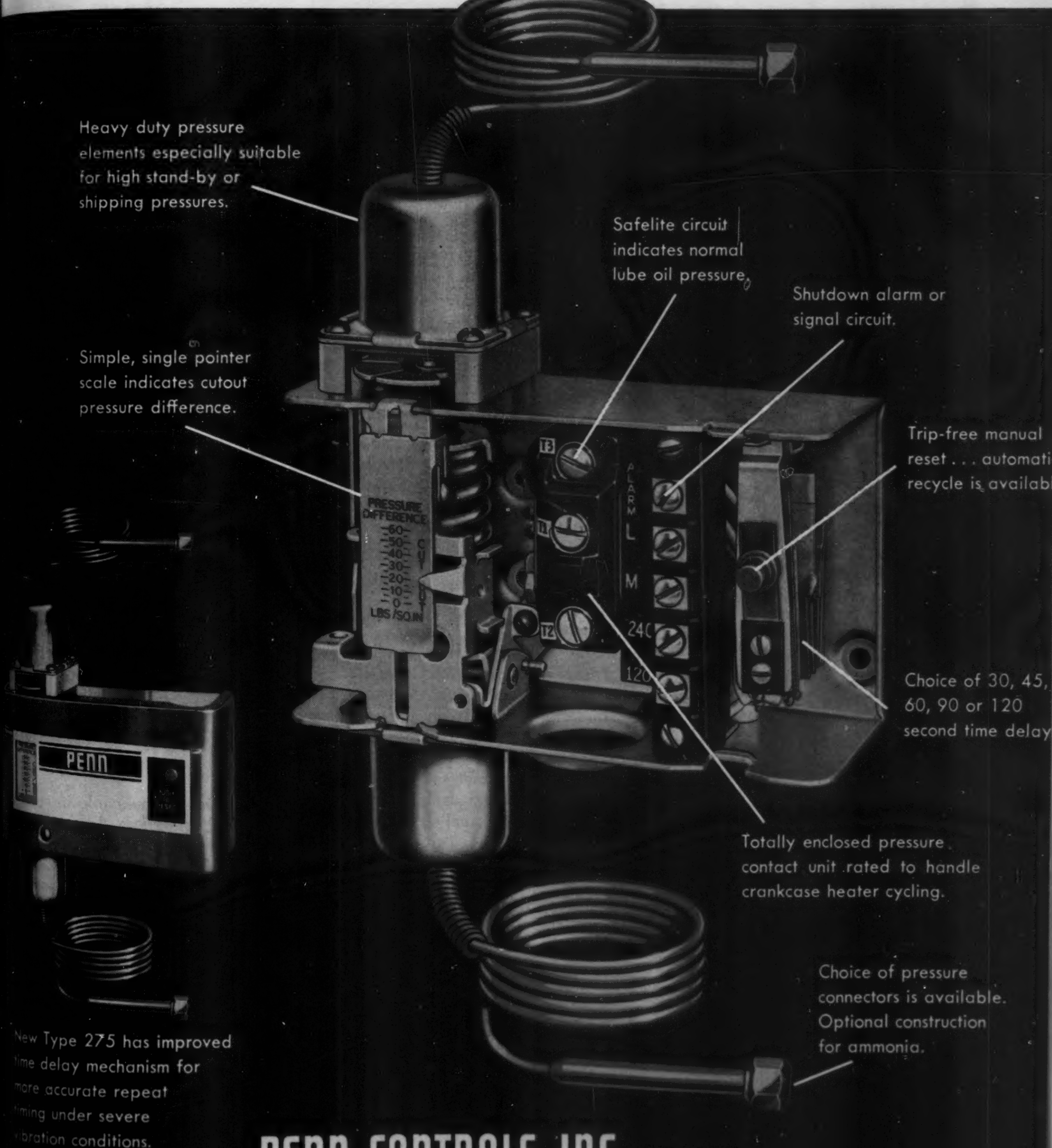
NOW

BETTER THAN EVER!

New Type 275 is the sure way to stop slow pickup or loss of lube oil pressure from crippling pressure-lubricated refrigeration compressors . . . get the complete story from your wholesaler!



PENN CONTROLS, INC. Goshen, Indiana

EXPORT DIVISION: 27 E. 38th ST., NEW YORK, N. Y.

AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING, APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES

BULLETINS and CATALOGS

Flexible Tubing Manual. New methods for handling air, liquids and light solids with nonmetallic flexible tubing are now available in six-page Catalog 10-19, "Facts about Flexible Tubing." Provided in the manual is an extensive description of the varied forms, major advantages and uses of this tubing. Basically a synthetic material or fabric cover supported by a coiled spring, flexible tubing is available in many variations and sizes.
Flexible Tubing Corporation, Guilford, Conn.

Motor Propeller Fans. Selection data for choosing the right self-cooled motor propeller fan for a specific application are contained in 20-page Catalog DB1-100. Selection tables are provided for seven series of Type LQ all-around fans, five series of Type PQ high-speed fans, seven series of Type TA and TAQ direct-drive tubeaxial duct fans and two series of Type XQ explosion-proof fans. In addition, there are pages for propeller fan accessories, wall ventilators of several types, ceiling ventilators and cooling and circulating fans.
Ilg Electric Ventilating Company, 2850 N. Pulaski Rd., Chicago 41, Ill.

Packaged Bearings. Operating principle and characteristics of a new "Hy-Film" line of packaged bearings which run on hydrodynamic oil films are described and illustrated in a four-page bulletin. Included are charts showing amounts of torques and hp loss at different speeds and temperatures.
Tann Bearing Company, 2741 East Congress, Detroit 7, Mich.

Scotch Marine Steam Boiler Plants. Automatic horizontal 3-pass Scotch Marine Steam Boiler Plants are covered in four-page Bulletin A-104-3. Design and construction features are explained and specifications provided. Boilers are described as being fully assembled with burners, complete control equipment and safety devices ready for installation.
Eclipse Boiler Div, Manufacturers Rd. and Compress St., Chattanooga 5, Tenn.

Air Handling Blower-Coil Units. Information on "Luxaire" 3, 4 and 5 ton blower and cooling coil units is provided in a 2-page flyer illustrating how the units can be installed with either horizontal or vertical air discharge and end, bottom or side air intake.
C. A. Olsen Manufacturing Company, Elyria, Ohio.

Self-Contained Air Conditioners. Design advantages and functions performed by Self-Contained Airditioners are described specifically in Bulletin 760. Features of this unit are: forced air heating with electricity, steam or water; cooling supplied by the refrigeration unit; dehumidifying; recirculating room air; introducing outside air; and filtering all air handled by the unit.
Modine Manufacturing Company, 1500 DeKoven Ave., Racine, Wisc.

Steel Spring Machinery Mounts. Currently available data on eliminating vibration, shock and noise transmission by using steel spring machinery mountings is presented in six-page Bulletin K3C. Eight case histories, with installation photographs, describe how these mountings aided solution of a variety of vibration problems. Data tables give capacities and characteristics of the Series "L" Vibro-Isolator, including isolator sizes, capacities, dimensions and shipping weights.
Korfund Company, Inc., 48-53D 32nd Pl., Long Island City 1, N. Y.

Diaphragm Valves. Three modifications of Impervite impervious graphite diaphragm valves are covered in ten-page Bulletin 1610, which includes product illustrations, engineering drawings and dimensions, as well as charts showing C_v factors for each size. Valves are cited as being immune to effects of thermal shock, noncontaminating and accommodating operating temperatures to 340 F and pressures to 50 psi. They are furnished in seven sizes from one to eight in. diam.
Falls Industries, Inc., Solon, Ohio.

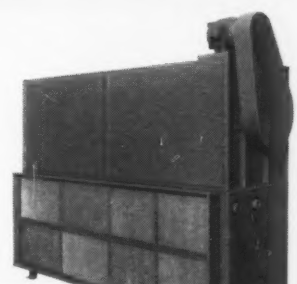
Ventilating Set Catalog. Discussed in 20-page Catalog 1160 is a complete line of direct connected and V-belt driven ventilating sets, used in a variety of applications, such as supply and exhaust, general ventilation, kitchen and laboratory exhaust, process air cooling and corrosive and explosive fume exhaust. Provided in the catalog are extensive engineering data for both models, with volumes to 21,500 cfm and static pressures to 2½ in. water. Performance data for V-belt driven models feature two motor and V-belt drive selections to cover a broader performance range.
Westinghouse Electric Corporation, Sturtevant Div, Hyde Park, Boston 36, Mass.

Dip Coating. Flyer M-800 describes a water soluble, water-thinnable and nonflammable dip coating for protection of brass and brass-plated steel products. Product and application information and test results data are given.
Bee Chemical Company, 2700 E. 170th St., Lansing, Ill.

Thermal and Acoustical Insulation. Thermal and acoustical characteristics of Fine-Fyber Felt Insulation are presented in four-page Bulletin J-661. Composition and physical properties of the lightweight material, which is designed for service from sub-zero temperatures to 450 F, are described extensively. A table lists and discusses various factory applied facings and coatings available. Thermal conductivity of each standard density at various operating temperatures is given.
Baldwin-Ehret-Hill, Inc., 500 Breunig Ave., Trenton 2, N. J.

Tubing Tools. Shown in 32-page Catalog 3121 are more than 75 different tools and kits for all tubing work: cutting, flaring, bending, reaming, swaging, pinch-off, refacing and sizing. Also contained are data on such miscellaneous items as test caps and plugs, air nozzles, blowers, machinery cleaners and drum faucets. In addition, a five-page comprehensive replacement parts list is included.
Imperial Brass Manufacturing Company, 6300 W. Howard St., Chicago 48, Ill.

Air Curtain Door. Applicable in conjunction with cold room doors of all varieties, Coldnet is cited as minimizing problems of condensation formation and temperature rise from opening of cold storage room or freezer doors. A thin stream of cold air, produced by a blower located on the cold side of the door, is blown downward over the face of the door opening. This air stream, wider than the door opening, flows at an angle to direct its movement inward to mix with the refrigerated room air. Warm air, contacting this stream, rolls out at the floor line to retain a balance of air pressure between the inside and outside of the room, pre-



Thermal
Vertical Central
Plant

First National Bank, Fort Myers, Florida

Corpus Christi State National Bank, Corpus Christi, Texas

Satisfaction with THERMAL that can't be discounted

Numerous Bank Buildings Depend on Thermal for Comfort

As the reputation for quality and dependability of Thermal air conditioning and ventilating equipment becomes known, more and more banks, as well as all other types of buildings, are using Thermal.

This is equipment with quality to give satisfaction and long life. Design features combine ready accessibility of internal components with rugged construction.

For further details on air conditioning and ventilating equipment you can specify with confidence, write for complete catalog and names of nationally known concerns using Thermal. The Thermal line includes central and multizone conditioners, sprayed coil units, heating and ventilating units, heating and cooling coils, and air-cooled condensers.

Here are **some** of the banks using Thermal equipment:

East Lake Branch of Birmingham Trust National Bank, Birmingham, Ala.
Commercial Bank, Andalusia, Ala.
Commercial National Bank, Daytona Beach, Fla.
First National Bank, Ft. Lauderdale, Fla.
Dade National Bank, Miami, Florida
Florida National Bank at Brent, Pensacola, Fla.
First Federal Savings & Loan Bldg., Hattiesburg, Miss.
East Central Branch, Bank of New Mexico, Albuquerque, New Mexico
Bank of Broken Arrow, Broken Arrow, Oklahoma
First National Bank, Muskogee, Oklahoma
First National Bank, Abilene, Texas
First Savings & Loan Bldg., Corpus Christi, Texas
Austin Savings & Loan Co., Austin, Texas

North Austin State Bank, Austin, Texas
Security State Bank, Beaumont, Texas
American National Bank, Beaumont, Texas
Farm-Home Savings & Loan Bldg., Ft. Worth, Texas
Raymondville State Bank, Raymondville, Texas
First National Bank, Rockport, Texas
Bellaire State Bank, Bellaire, Texas
Lockhart Savings & Loan Bldg., Lockhart, Texas
First National Bank, Giddings, Texas
Grove State Bank, Dallas, Texas
San Jacinto State Bank, Houston, Texas
First National Bank, Refugio, Texas
Tyler Bank & Trust Co., Tyler, Texas

Quality Products Since 1945

THERMAL ENGINEERING CORPORATION

2605 W. DALLAS • P. O. BOX 13254
HOUSTON 19, TEXAS

AGENTS IN PRINCIPAL CITIES

venting all but a min amount of warm air from mixing with the cold. System is detailed in four-page Specification N Form MS167-TM.
York Div, Borg-Warner Corporation, York, Pa.

Oil Burner Control. Burner-mounted, this control for use on domestic oil burners is the subject of four-page Bulletin R-1688, which describes and illustrates the unit. Designated Kwik-Sensor, it need only be positioned where it can pick up the radiant rays of the oil flame.
White-Rodgers Company, 1209 Cass Ave., St. Louis 6, Mo.

Environmental Testing. Data on environmental testing and other applications for controlled atmospheric conditions presented in 32-page Bulletin 600 includes a pictorial chart summarizing available data on altitudes from sea level to 2,000,000 ft. Shown are specific weight, pressure, acceleration of gravity and molecular weight at the various altitudes. Other charts give technical information on atmosphere, temperature and humidity. Nine main environmental applications are reviewed and details are presented on 13 types of chambers and low temperature freezers. In addition, data is included on temperature performance, specific heat of various substances, metal shrinkage, low temperature refrigerants, conversion fluids, temperature conversion and temperature controls.
Webber Manufacturing Company, Inc., P. O. Box 217, Indianapolis 6, Indiana.

Packaged Boilers. Forced-draft Scotch Type packaged boilers for high and low pressure applications are covered with illustrations in 12-page Bulletin 149D. These packaged boilers can be fired with natural gas, various grades of fuel oil or combination gas and oil, and have certified output ratings from 83 to 691 hp for the low pressure units and 82 to 672 hp for high pressure units.
American Radiator and Standard Sanitary Corporation, Industrial Div, Detroit 32, Mich.

Underground Steam Lines. Methods for use of "Z" Crete brand systems of insulating concrete conduit for rehabilitation of existing underground heating lines to restore their original efficiency are illustrated and described in a four-page bulletin. Common sources of trouble in metal conduit, split tile, concrete box or hydrocarbon fill insulating systems are discussed and use of the "Z" Crete system best matched to soil and water conditions is outlined. In typical installations, the existing casing is removed, all insulation cleaned out and support blocks replaced as necessary. Internal vents and drains are installed in the lower corners and water-resistant insulating concrete pumped into place. A cover of membrane placed over the concrete provides a watershed.
Concrete Thermal Casings, Inc., 2107 N. 34th, Seattle 3, Wash.

Centrifugal Fan Cooling Towers. Available in sizes from five to thirty-ton capacity for either horizontal or vertical air flow, the towers discussed in four-page Bulletin ECKB-601 are designed for indoor installations requiring long ductwork runs. Charts show operational and dimensional as well as take-apart dimensional data.
Halstead & Mitchell Company, Bessemer Bldg., Pittsburgh 22, Pa.

Hydronic Heating and Cooling. Coordination of the air conditioning system with interior decoration considerations of a home is illustrated in 20-page Bulletin JA460, "The Hydronic Home." Subject of the bulletin is application of circulated water systems to residential heating and cooling.
Bell & Gossett Company, Morton Grove, Ill.

Stainless Steel Tubing. Designed as a guide to this manufacturer's stainless steel products, four-page Bulletin 7247 provides charts showing size ranges, analyses and standard tolerances. Cut-away views illustrate the fine interior finish of the tubing. Information about testing facilities which perform pressure, tension, ultrasonic eddy current, hardness, flattening, flaring, flanging, dye penetrant, micro-in. finish, bending and other tests is outlined.
Columbia Steel and Shafting Company, Pittsburgh 30, Pa.

Oil Valve. Designed for precision control of oil flow to any type burner, Micro-Cam oil valve is the subject of four-page Data Sheet No. GA704FC. Valve capacities are tabulated and applications are discussed, with diagrams showing dimensions of the units.
Hauck Manufacturing Company, 124-136 Tenth St., Brooklyn 15, N. Y.

Heavy-Duty Fans. Three-page Bulletin DB1-106 offers information on heavy-duty, square panel, self-cooled propeller fans for virtually all types of industrial and commercial installations and sound-level classifications. Rating tables are given for fans with constant and two-speed, one and three-phase motors. Tables also cover size, rpm, hp, decibel rating, sound class and cfm output, together with approximate weights and specific dimensions.
Ilg Electric Ventilating Company, 2850 N. Pulaski Rd., Chicago 41, Ill.

Weatherstripping. Types of weatherstrip material and their uses and information on weatherstripping against dust, noise, drafts, leaks and light are presented in a 16-page bulletin, designated "What you should know about interior and exterior weatherstripping." Emphasis has been placed on commercial and industrial applications.
Pemko Manufacturing Company, Emeryville, Calif.

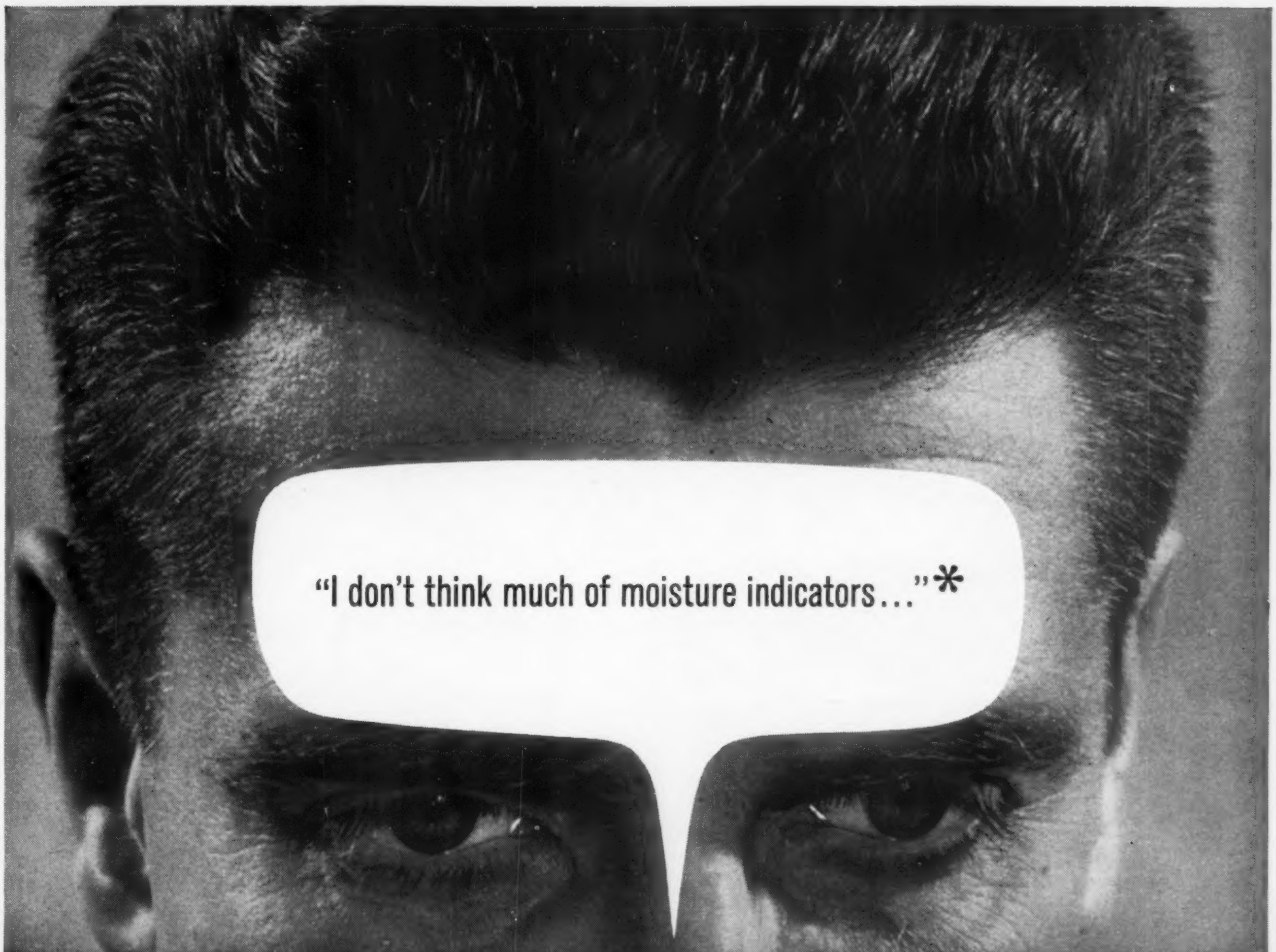
Thermocouples. Metal-sheathed, ceramic-insulated construction of these thermocouples is explained and typical applications are cited in six-page Bulletin P1281A. A feature of the bulletin is a table giving complete specifications of various Armorox thermocouples available.
Bristol Company, Waterbury 20, Conn.

Throttle Valves. Illustrated and described in four-page Bulletin 460 are Le-Hi Series 2500 throttle valves for control of compressed air on pneumatic operating equipment. Also shown are air hose fittings offered by the manufacturer.
Hose Accessories Company, 2720 N. 17th St., Philadelphia 32, Pa.

One-Piece Pipe Insulation. Thermal and physical characteristics of Mono-Kover, a one-piece pipe insulation for service from below zero to 350 F, are described in four-page Bulletin J-660. Thermal conductivities of the lightweight, resilient, mineral fiber material are shown graphically. Tables present available sizes and thicknesses according to nominal pipe sizes and actual pipe OD. Recommended thicknesses for various pipe sizes and operating temperatures, based upon the heat loss desired, are suggested.
Baldwin-Ehret-Hill, Inc., 500 Breunig Ave., Trenton 2, N. J.

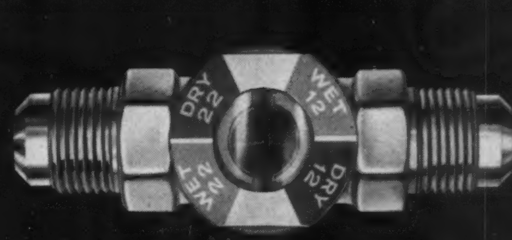
Air Compressors. Reciprocating carbon-ring air compressors for hospital and laboratory central systems, which deliver oil-free, low temperature air at max volume per kw hr, are the subject of Bulletin NM-285.000. Drawings and dimension tables give details of the horizontal receiver mounted unit, base plate mounted unit and vertical receivers. Duplexing of air compressors is discussed and diagrams show three suggested ar-

(*Continued on page* 90)



*PERHAPS THAT'S BECAUSE YOU HAVEN'T TRIED ANSUL'S BRAND NEW "200" DRY-EYE, SIR! In this unique refrigeration service aid, the Refrigerant-12 indicator, the Refrigerant-22 element and the sight glass are combined in one unit which screws out easily, in one piece, to permit worry-free soldering of sweat connections. No jig-saw puzzles to put together when you have to remove the core of the unit . . . no possible way of damaging the elements during installation. ▌ Most moisture indicators are notoriously inaccurate in showing the moisture content of Refrigerant-22. Refrigerants vary markedly in their moisture characteristics and an R-12 indicator just won't do the job on 22. However, the "200" Dry-Eye has a separate, true Refrigerant-22 indicator—painstakingly designed to show scientifically the moisture content that signals danger in R-22 systems. ▌ "200" Dry-Eyes are available in all standard sizes, flare and sweat, in both the in-line models (L-200) and the popular T models (T-200). This latter, when attached to the Ansul T-Flo Drier, provides a complete moisture control system. See them now at your refrigeration wholesalers' or write directly to the Ansul Chemical Company for additional information.

ANSUL



ANSUL CHEMICAL COMPANY • MARINETTE, WISCONSIN | FIRE EXTINGUISHING EQUIPMENT • REFRIGERATION PRODUCTS • INDUSTRIAL CHEMICALS

Lambert Municipal Airport, St. Louis

The administration building at St. Louis Lambert Municipal Airport has taken its place among the world's masterpieces of contemporary architecture.

Airline customers have discovered, too, that this dramatic structure by Hellmuth, Obata and Kassabaum blends modern design with unbelievable convenience and efficiency.

Another touch of comfort was added recently with the year-round air conditioning of the three "fingers", or covered walkways, extending from the main building to areas where planes discharge and take on passengers.

Two hundred and twenty-three Marlo "Seazonaire" remote fan coil units of 300 to 800 cfm were installed by Guaranteed Heating and Engineering Company. Using chilled or heated water from a central source, these compact units provide perfectly conditioned air in summer and winter. Consulting engineers for the installation were Ferris & Hamig.

For further information about practical, efficient "Seazonaire" air conditioning units by Marlo, see the Marlo representative in your area or write to us direct.

Marlo coil co.

SAINT LOUIS 11, MISSOURI

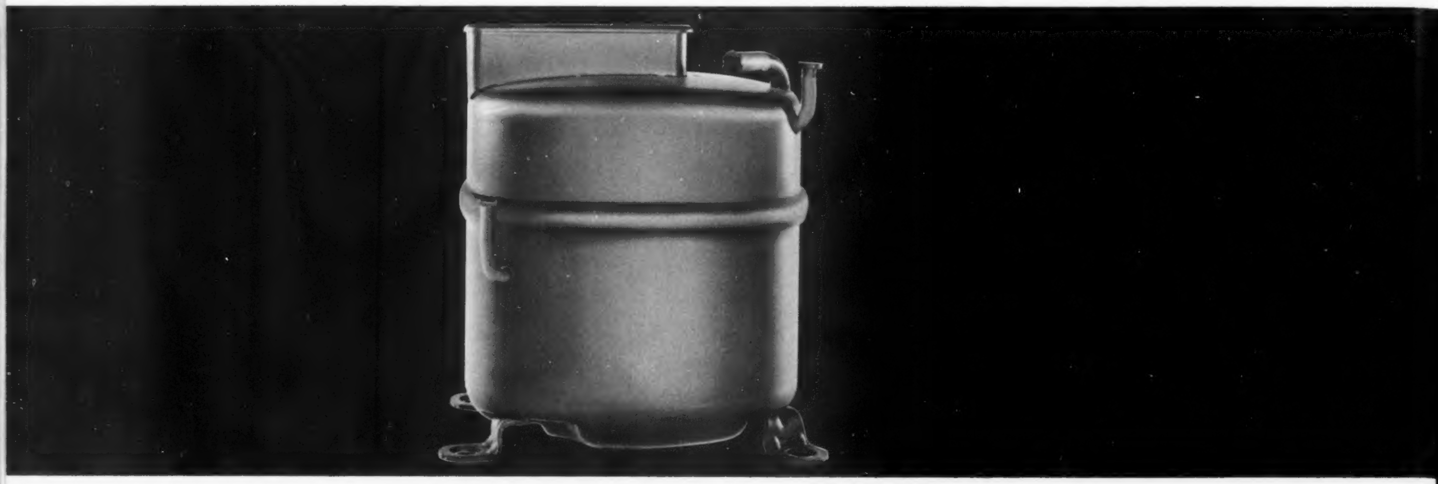
Quality Air Conditioning and Heat Transfer Equipment Since 1925

SING A SONG OF SIZES . . . UP AND DOWN THE SCALE.

Whatever the requirements of your refrigeration or air conditioning equipment may be, chances are there's a Bendix-Westinghouse compressor and condensing unit to fill them. For Bendix-Westinghouse offers a complete range of sizes and capacities—from 1/4 hp on up through 5 hp. And they're all designed for tight-squeeze quarters. No other compressors of their size deliver so many BTU's. Turn the page for important news about the newest member of the Bendix-Westinghouse line.

Bendix-Westinghouse MOTOR COMPRESSORS

NOW! SIX BENDIX-WESTINGHOUSE COMPRESSOR SIZES BRING NEW ROOM COOLER DESIGN FREEDOM



This new Bendix-Westinghouse compressor series gives manufacturers of window air conditioners a wide range of capacities for complete line planning:

Model	BTU's	Volts
YCH137VA-1	6,100	115
YCH161VA-1	7,100	115
YCH222VA-1	10,000	115
YCH222VA-2	10,000	230
YCH260VA-2	12,000	230
YCH322VA-2	15,000	230

Available with three or four legs, the compressors are easily and permanently bolted down in the unit. They require no mounting straps or other gadgetry, since all models are internally spring-mounted. And they are *quiet!*

Valve construction is rugged, assuring long life and dependable supply of cooling needs. Aluminum crankcase construction and modern design reduce weight, saving shipping costs both into and out of your plant. For easy access and service, the tubing connections and terminal box are located on top. Insulation for the two-pole motor is of the latest and best type.

Because Bendix-Westinghouse compressors are quiet, they are ideal for bedroom-window units—a potent sales feature for you. Get all the facts on the versatile line of Bendix-Westinghouse compressors. Call or write direct.

Bendix-Westinghouse

EVANSVILLE, INDIANA

A Division of Bendix-Westinghouse Automotive Air Brake Company, Elyria, Ohio
Export Sales: Bendix International, 205 E. 42nd St., New York 17, N.Y.

We've hitched our Star to a Wagon

Quality is . . . as quality does. When our specialized manufacturing methods and ultra precision controls produce the fine thin wall copper tube for which Viking is known, a symbol should present our appreciation of this achievement. Does our "star product" carefully being placed in a Rolls Royce chauffered by three of Viking's top executives get this idea across to you quickly?

VIKING copper tube co.
CLEVELAND 10, OHIO

The 1937 Phantom III, 12-cylinder Rolls Royce is a Classic. Formerly belonging to the Lord Mayor of Kingston-on-Hull, it is now in our service. Viking personnel, however, drive American made cars.

BULLETINS

(Continued from page 84)

rangements. Motors, switches, starters, transfer switches and optional accessories including regulators, filters and dampeners are described.
Chemetron Corporation, National Cylinder Gas Div, 840 N. Michigan Ave., Chicago 11, Ill.

Air Conditioning Equipment. Commercial and residential air conditioners, heat pumps, gas-fired furnaces, electrostatic air filters and the Comfort Center, a twin-system air conditioner, are covered extensively in a 16 page bulletin. General specifications for each model are presented in tabular form.
York Div, Borg-Warner Corporation, York, Pa.

Duct Liner. Micro-Bar dual-density glass fiber duct liner is described in eight-page Bulletin IN-302A, which stresses advantages of the material in checking air erosion, reducing noise and improving insulating efficiency. Description of the material, which is a resilient, semi-rigid blanket type insulation composed of a strong, fine inorganic glass fiber bonded by a thermosetting resin to form two different densities of insulation, is also included. Illustrations demonstrate various application techniques and extensive specifications are provided.
Johns-Manville Corporation, 22 E. 40th St., New York 16, N. Y.

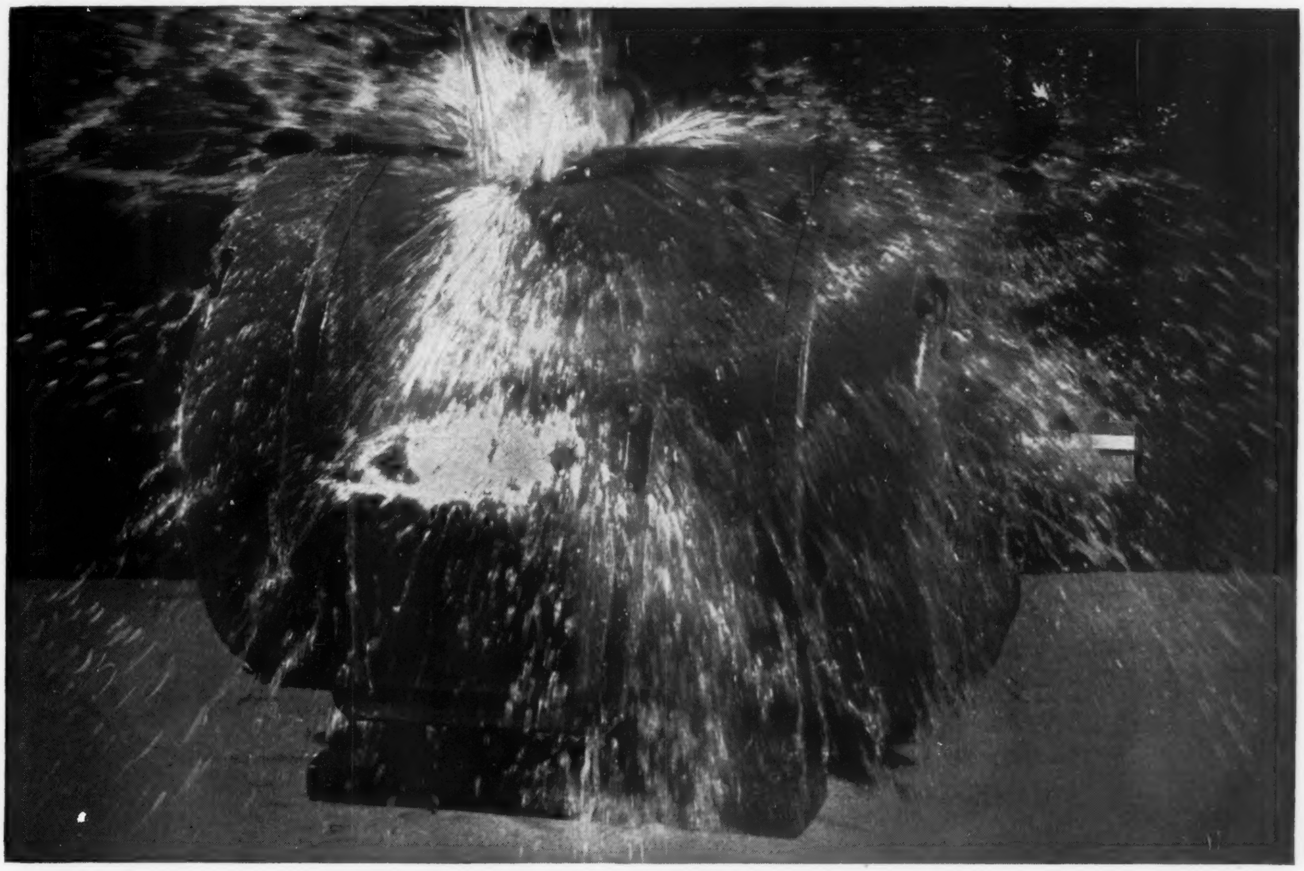
Plumbing Products. Emphasizing residential and small commercial equipment, condensed Catalog PT60 has fixtures and fittings coordinated on each page for complete and easy reference and follows the basic format of the larger plumbing catalog.
American Radiator & Standard Sanitary Corporation, Plumbing & Heating Div, 40 W. 40th St., New York 18, N. Y.

Heating and Ventilating Units. Detailed information regarding sizes, capacities, accessories and applications is given for Seasonvent units in 24-page Catalog 575. Provided is a detailed series of selection data charts to enable engineers to select the proper unit for particular applications, and dimensional and arrangement data. Units are available in nine sizes for low static application (zero to 1¼ in.) and in seven sizes for high static operations (one to two in.) with nominal capacities from 1250 to 15,000 cfm.
McQuay, Inc., 1600 Broadway St. N.E., Minneapolis 13, Minn.

Silicones. How silicones aid appliance design, performance and manufacture is the subject of 8-page Bulletin 1-116. Described are appliance uses for silicone rubber, paints, fluids, lubricants and electrical insulation. Included are illustrations, graphs and tables.
Dow Corning Corporation, Midland, Mich.

Air Conditioner Manual. Included in this 12-page manual, Bulletin 6022, are product details and technical data on this company's packaged air conditioner line. Sections of the manual cover accessories, capacity specifications, dimensional data, ratings, piping diagrams, wiring diagrams and warranty.
Dunham-Bush, Inc., 179 South St., West Hartford, Conn.

V-Band Couplings. Extensive design information on V-band couplings for connecting and sealing all types of tubing, piping, ducts, containers or structural devices for both aircraft and industrial applications is included in a four-page bulletin. Coupling sizes



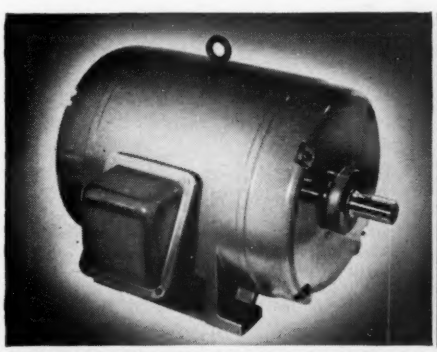
Sudden Splash or Soaking Shower

won't stop a Wagner® DP Motor . . .

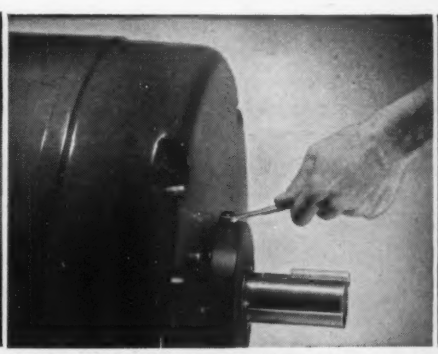
Wagner® Type DP Motors are doubly protected by rugged, corrosion-resistant cast iron frames and dripproof enclosures. Splashing or falling liquids, corrosive acids, salts, and alkalies can't stop their smooth operation. Designed to meet a wide variety of applications— including many that used to require splashproof motors—Wagner Doubly Protected Motors pack plenty of power into precious little space, are lightweight, long-lived, and pare downtime and upkeep costs to the bone. Simply put . . . they get the job done. Let your nearby Wagner Sales Engineer show you how these motors can be applied to your needs. Call him, or write for Bulletin MU-223.

Wagner Electric Corporation

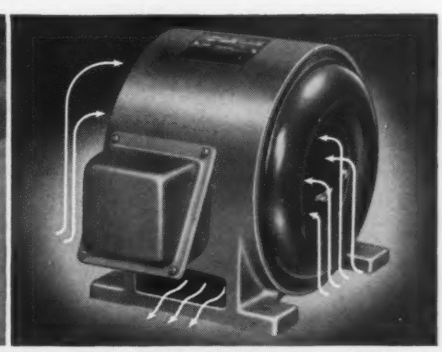
6379 PLYMOUTH AVE., ST. LOUIS 33, MISSOURI



SLEEVE BEARING MODELS AVAILABLE . . . DP Motors are built in NEMA frame sizes 182 through 445U; 1 through 125 hp—1750 RPM—40°C; available with ball bearing construction as illustrated or steel-backed, babbitt-lined sleeve bearings. Larger motors (Type RP) are available through 1000 hp.



CAN BE RELUBRICATED . . . Original factory lubrication will last for many years in normal service, but openings are provided to permit the relubrication that adds years to motor life under severe conditions.



COOL RUNNING . . . Specially designed baffles direct cooling air through the motor to reduce stator temperature, thus increasing motor life. Blowers, cast as part of the rotor, move large volumes of air without noise or vibration.

WM60-20

can be obtained in any increment from the min diam of the particular coupling to the max diam of the application.
Aeroquip Corporation, Marman Div, 11214 Exposition Blvd., Los Angeles 64, Calif.

Shielded Motors. Included in 56-page Catalog 200 are complete pricing and dimensional data on motors of this type, ranging from ¼ to 200 hp. Information is given for various modifications, such as specialized mountings and enclosures, as well as new Sterlicone drip-proof motors. A special section deals with motor selection and application.
Sterling Electric Motors, Inc., 5401 Telegraph Rd., Los Angeles 22, Calif.

Temperature Regulators. Eight-page Catalog J180-1 contains extensive information on the complete line of sliding gate and plate temperature regulators available from this manufacturer. Designed for use on steam, water, air, oil, gas or chemicals, sliding gate regulators control temperatures from 35 to 450 F, at pressures to 250 psig. Self- and pilot-operated temperature and combination temperature/pressure regulators are illustrated by photographs, cut sections and line drawings. Included in the catalog are features, applications, sizing charts, flow curve, sample specifications and extensive engineering information.
OPW-Jordan Corporation, 6013 Wiehe Rd., Cincinnati 13, Ohio.

Attic Fans. Outlining advantages of ventilating with Ventura line fans, four-page Bulletin A-114 presents a step-by-step procedure for fan selection. Capacities for the various Model CA and CAV fan sizes available are tabulated along with fan speed, motor hp, nominal wheel diam and approximate net weight. Installation dimension drawings are presented for the full line and include mounting recommendations for both suction box and ceiling opening applications.
American Radiator & Standard Sanitary Corporation, Industrial Div, Detroit 32, Mich.

Thermostat. With eight standard ranges up to 1150 F, Model S-1S thermostat is a miniature differential expansion type control incorporating a snap-action switch rated five amp 125/250 volt ac, 30 amp 30 volt dc. Open style or Nema type 1 enclosure models are available. Flyer 122.
Burling Instrument Company, 16 River Rd., Chatham, N. J.

All-Electric Heating. For residences with air conditioning, the all-electric heating system diagrammed in four-page Specification BR Form PM 456-S features individual room control, low voltage control system, low duct heat loss with heating units near outlet diffusers and a single model electric duct heater suitable for heating requirements from 530 to 8530 Btu/hr.
York Div, Borg-Warner Corporation, York, Pa.

Insulation Protection. Complete line of aluminum products for protecting insulation on piping, tanks or towers is introduced in four-page Bulletin ICB. Also included is a brief summary of other insulation accessory products.
Insul-Coustic Corporation, 42-23 54th Rd., Maspeth 78, N. Y.

Motor-Starter Relay Tester. Motor starters and small magnetic and thermal circuit breakers can be checked with test units discussed in Flyer SB-MSR-1. Application of either unit, Model JR-1 rated at 0.4 kva and Model CB-10 at one kva, is determined by the current required to

(Continued on page 95)

MORE EFFICIENT

SAFER

PROTECT EQUIPMENT

SIMPLIFY MAINTENANCE

SAVE MONEY

NEW PHILLIPS

REFRIGERATION CIRCULATING and RETURN SYSTEMS

• substantially reduce operating costs through—more efficient use of all components . . . complete protection of compressors, more efficient heat transfer, central liquid control . . . save operator time.

• adapt to existing plants with only minimum additional equipment—uses your present components to good advantage, nothing to tear out!

• adapt to new construction by simpler, more efficient system design—fewer components required!

• controlled low pressure is the secret that permits complete flexibility in the use of equipment—you can use automatic float controls or simple hand valves . . . facilitates hot gas defrosting as well as oil return, etc.—no high cost components needed!

get the facts . . . NOW

See your Phillips Representative or write for details

H. A. PHILLIPS & CO., 3255 W. Carroll Ave., Chicago 24, Ill.

DESIGNERS AND ENGINEERS/REFRIGERATION CONTROL SYSTEMS

Another Tinnerman Original...

Self-retaining "U" and "J" SPEED NUTS®
cut assembly costs up to 50% or more!

If you are worried about rising assembly costs, let one-piece "U" and "J" SPEED NUTS keep costs down . . . and improve your product.

They can't fall off, once they've been pressed into screw-receiving position. No welding, staking or other secondary fastening devices needed. You eliminate lock washers—spring steel SPEED NUTS are self-locking, make vibration-proof attachments.

SPEED NUTS are ideal for blind assembly or hard-to-reach locations. Apply them *before* you paint panels without danger of paint-clogging. Or *after* porcelainizing, without damage to finishes. The "U" type is similar to the "J" type, shown above, but is used where full bearing surface on the lower leg is required.

A free Fastening Analysis can tell where SPEED NUT brand fasteners belong on your products. Call your Tinnerman representative—he's listed in most major telephone directories. Or write to:

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Dept. 12 • P. O. Box 6688 • Cleveland 1, Ohio

TINNERMAN

Speed Nuts®

FASTEST THING IN FASTENINGS®

CANADA: Dominion Fasteners Ltd., Hamilton, Ontario. GREAT BRITAIN: Simmonds Aerocessories Ltd., Treforest, Wales. FRANCE: Simmonds S. A., 3 rue Salomon de Rothschild, Suresnes (Seine). GERMANY: Mecano-Bundy GmbH, Heidelberg.

Others are saying—

(Continued from page 77)

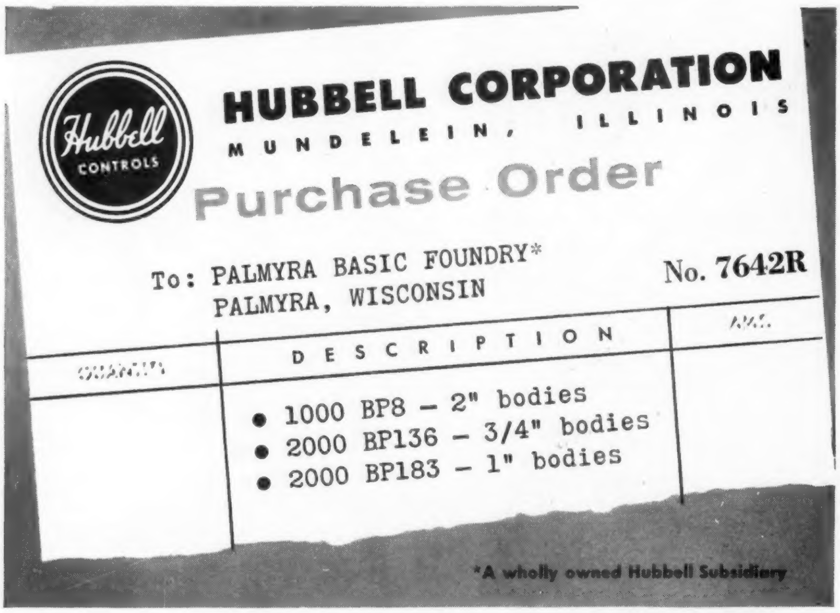
return water from the radiators before it flows into the radiators again, or thermostatic radiator valves may be fitted on the radiators. The latter is cited as being the more desirable, ensuring automatic control of individual rooms at temperatures independent of the boiler temperature. *Danfoss Journal, No. 2 1960, p 23 (Denmark).*

that . . . . . . design of a quiet air conditioning system demands careful consideration of the many sources of noise it contains and the way in which these noises can be transmitted to occupied spaces. Available design data provide a base for determining how much the primary paths of transmission must be treated to quiet principal sources of noise. Other paths of transmission and other sources of noise may inadvertently arise to upset the acoustic design. In this report, the experience of a number of engineers has been called upon to indicate some of the ways in which noise control design can fail. *Heating, Piping & Air Conditioning, August 1960, p 141.*

that . . . . . . in refrigerated distributor warehouse design, complicated two-stage plants are normally utilized with independent forced circulation ammonia systems, operating separately in accordance with requirements of the various load temperatures. Such systems do not allow flexible balance of the integral heat loads of the warehouse. A refrigerating system is herein proposed with interchangeable, one-stage compressors operating at a suction pressure (on the order of 1.4 to 1.6 kg/cm^2) to meet all refrigeration requirements of the various loads. Vapor jet units, mounted in the suction lines of each refrigerated space, lower the ammonia evaporating pressure to the necessary levels by bleeding off working vapor before the condenser. *Refrigeration Techniques (Xolodil'naya Technika), May-June 1960, p 12 (Russia).*

that . . . . . . investigation of noise levels due to a centrifugal compressor installed in an office building penthouse shows that when the fancoil unit is off, compressor noise levels are controlling. From this standpoint, it would be desirable to provide better insulation for the compressor. However, when the fancoil unit is operating, it provides a relatively useful masking noise. Emphasized in this article is the need for complete isolation of a mechanical system and not just the base of the machine. *Noise Control, May-June 1960, p 44.*

that . . . . . . utilization of resonance is cited as permitting an increase in the capacity of a hermetic compressor, shown by experiments conducted on coincidence of frequencies, between vibrations caused by motion of the piston of a compressor and natural oscillation of a gas column in the suction line. *Refrigeration Techniques (Xolodil'naya Technika), May-June 1960, p 21.*


HUBBELL CORPORATION
MUNDELEIN, ILLINOIS
Purchase Order
To: PALMYRA BASIC FOUNDRY*
PALMYRA, WISCONSIN
No. 7642R
DESCRIPTION
• 1000 BP8 – 2" bodies
• 2000 BP136 – 3/4" bodies
• 2000 BP183 – 1" bodies
*A wholly owned Hubbell Subsidiary

Nothing is left to chance . . . Hubbell makes its *own* castings to guard the quality and superiority of its controls. *Every* casting must measure up to Hubbell standards.

This inside control of our own foundry craftsmanship is appreciated by Refrigeration Engineers. And rightly so. The proof of the pouring—slower, careful manual pouring—is in the testing. And the proof of the testing is clearly evidenced by the name Hubbell on engineering drawings everywhere.

Join the growing list of satisfied Hubbell customers by installing *service-free* controls.

Air Conditioning • REFRIGERATION • Industrial

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"Castings to finished controls . . . every inch HUBBELL!"

BULLETINS

(Continued from page 92)

test the tripping element, either magnetic or thermal types. Descriptions of significant features such as metering, timing, overload capacity and protection; and method of testing are presented in the bulletin.
Multi-Amp Div, Multi-Amp Electronic Corporation, Box 217, Union, New Jersey.

Industrial Fans. Featuring one-piece construction of blade with each unit die-shaped and press formed from heavy gauge steel, Crystal-Aire fans are manufactured in more than 2200 different industrial and 36 attic models. Six-page Catalog 30-D-1 presents product illustrations, descriptions and a table of basic designations and performance ratings.
Franklin-Morgan Company, Inc., Charlotte 1, N. C.

Finned Tube Radiation. Standard enclosures, trim pieces, accessories, flattop covers, correction factors, deluxe enclosures, arrangements and ratings are described and illustrated on finned tube radiation for steam and hot water in Bulletin 460.
Modine Manufacturing Company, 5200 DeKoven Ave., Racine, Wisc.

Moisture Monitor. Detailed specifications and capabilities of Type 26-312 Liquid Process Moisture Monitor are given in Flyer 26312. Instrument is cited as being capable of continuously analyzing water concentration in organic-liquid streams.
Consolidated Electrodynamics Corporation, a subsidiary of Bell & Howell Company, 360 Sierra Madre Villa, Pasadena, Calif.

Motor Replacement Plan. Enabling replacement of 1428 motor models with a small number of new replacement models, a fractional hp, shaded-pole motor replacement plan is described in two guidebooks, 12-page Bulletin GEZ-3023 for 51-frame motors and 16-page Bulletin GEZ-3024 for 21 and 11-frame motors. Approximately 90% of the company's 3½-in. diam motors can be replaced by four new models, five models may be used to replace up to 75% of the original 4-in. diam motors now in use and eight different 5-in. models can replace 64% of their original counterparts. Models included in the replacement plan are cited as being interchangeable with other motors of similar size and ratings. Motors that can be replaced as part of this plan include those now in use in condensing units, refrigerators and freezers, unit heaters and coolers, exhaust fans, room air conditioners and many other similar air moving or mechanical load applications.
General Electric Company, Schenectady 5, N. Y.

Dual Duct Air Conditioning. Details on the application of Dual Duct Air Conditioning along with schematic drawings of typical Dual Duct arrangements are offered in a 16-page Bulletin DD-7. Designed to maintain a desired temperature for comfort air conditioning in buildings having many zones with varied heating and cooling requirements, this system has found application in structures where selective temperature control in individual spaces is required.
Buensod-Stacey Corporation, 45 West 18th St., New York 11, N. Y.

Portable Charging Cylinders. Added to this line of cylinders for refrigerant measuring and charging are a new size and some design changes. Shorter and more compact design make the new five-lb cylinder easy to carry, and the unit features a set of detachable legs for standing it in operating position, as well as a combination purge and relief valve for more rapid handling of refrigerant. All three models in the line have a measuring scale calibrated for three types of refrigerant, with a choice of Refrigerants 12, 22 and 114 or 12, 22 and 500 on one scale. Flyer SP-600720.
Airserco Manufacturing Company, 435 Melwood Ave., Pittsburgh 13, Pa.

Glass Fiber. Technical data on properties of glass fiber are a feature of four-page Bulletin TD-100. Applications of the material are listed, in particular, for use in package cushioning and vibration damping. Also shown is application of glass fiber to machine base mounts, acoustical insulation and molded insulation.
Fibrous Glass Products, Inc., a subsidiary of Pall Corporation, Alpa Plaza, Hicksville, N. Y.

Standard Blowers. Four-way discharge blowers, twin and triple assembly models, utility sets (enclosed drive) and cabinet blowers with one, two and three fans are the subject of 28-page Catalog STD-60. Typical specifications, capacity tables, performance curves and diagrammatic illustrations are among information presented.
Airfan Engineering Company, 7401 Telegraph Rd., Los Angeles 22, Calif.

Temperature Controls. Weather sensitive controls that govern inside comfort by outdoor temperatures are described in Bulletin G-0260. Controls operate with all fuels, including electric heat, in steam, hot water, warm air or radiant panel systems, and are designed for commercial, industrial and residential use. Weather-Man controls for steam systems and Weather-Flo for hot water and warm air systems are available with timing mechanism for daily or weekly programming. Weather-Chron, an automatic weather re-set time switch, is designed for use in any electric, pneumatic or electronic thermostat control circuit wherein space temperatures must be lowered at night or over the weekend and raised again automatically.
Automatic Devices Div, American Machine & Metals, Inc., 714 Hillgrove, Western Springs, Ill.

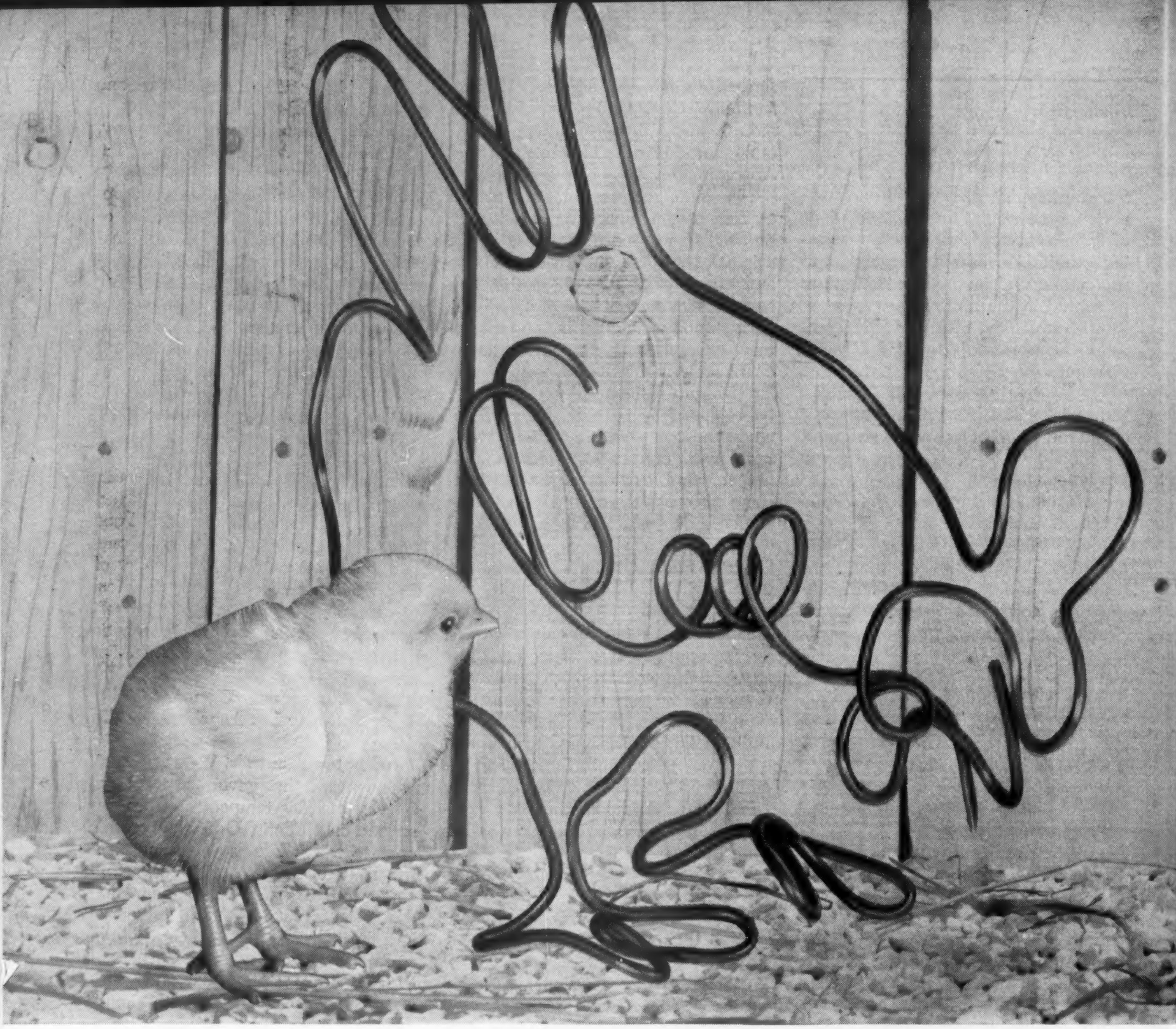
In recent months, the New York headquarters of ASHRAE has received numerous requests as to whether or not members are permitted to identify themselves with the Society on their personal and business letterheads and, if so, the proper method of such identification.

The Society encourages members to designate their affiliation with ASHRAE on personal and business stationery or when mentioned or quoted in the press. The correct method of designating your Society membership on your letterheads is stated in the By-Laws (Article III Membership, Sec. 3.11.)

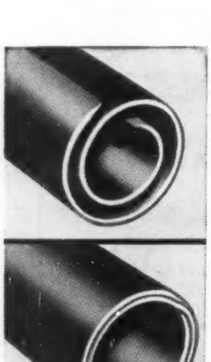
"No member shall describe himself in connection with the Society in any advertisement, letterhead, printed matter, or any other manner other than as an Honorary Member, Presidential Member, Life Member, Fellow, Member, Associate Member, Affiliate, or Student, as the case may be, except in official business of the Society."

An example of the correct way to designate your ASHRAE affiliation is as follows:

John J. Smith—Member, ASHRAE
John J. Smith Consulting Engineers, Inc.



There's almost no limit to the things Bundy can mass-fabricate



Bundyweld is the original tubing double-walled from a single copper-plated *steel* strip, metallurgically bonded through 360° of wall contact for amazing strength, versatility.

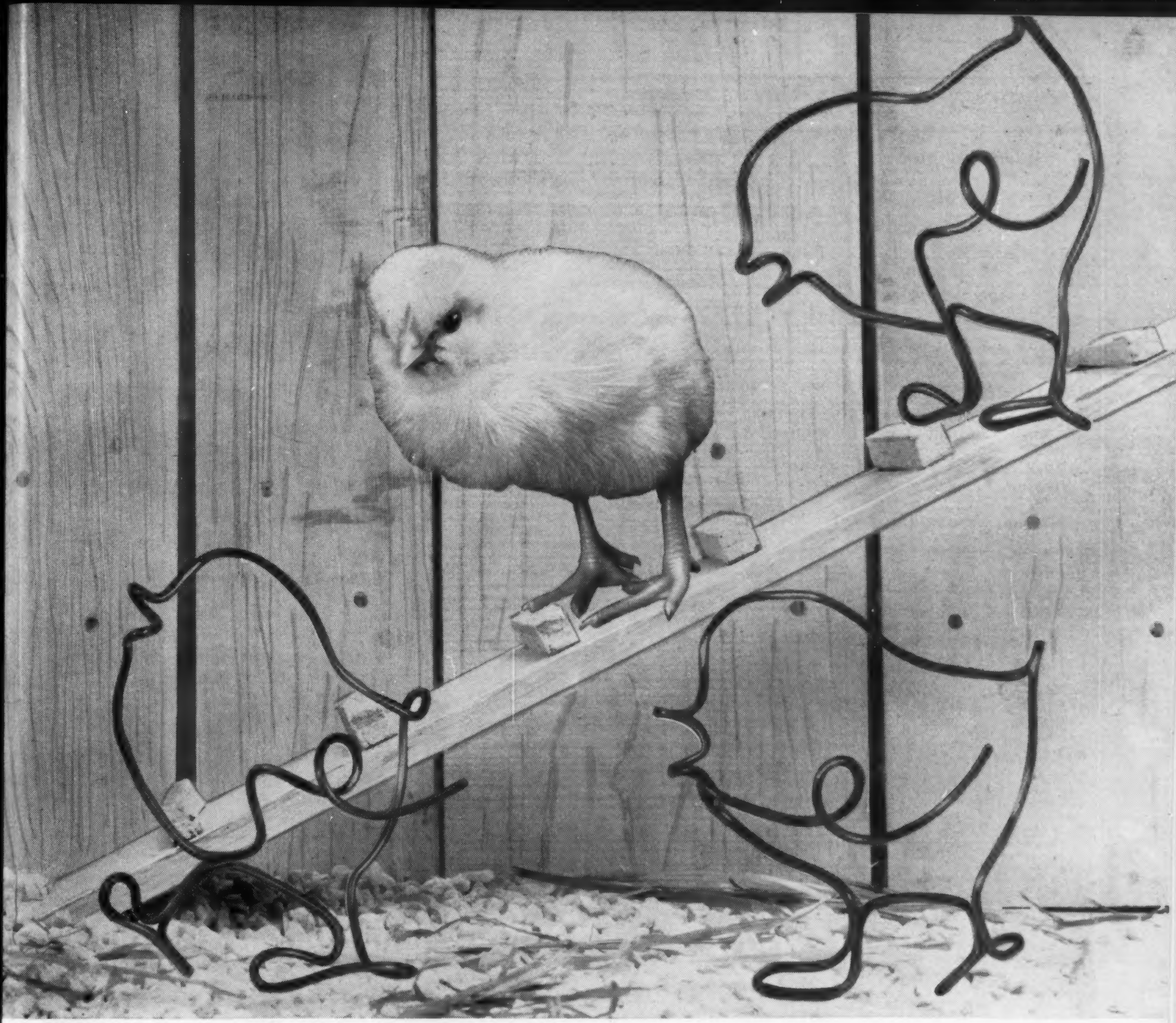
Bundyweld is lightweight, uniformly smooth, easily fabricated. It's remarkably resistant to vibration fatigue; has unusually high bursting strength. Sizes up to ⅝" O.D.

The old adage, "Don't count your chickens before they hatch," is a good one . . . but it rarely applies to Bundy. That's because, no matter how complex your tubing problem, you *can* count on Bundy for the perfect solution.

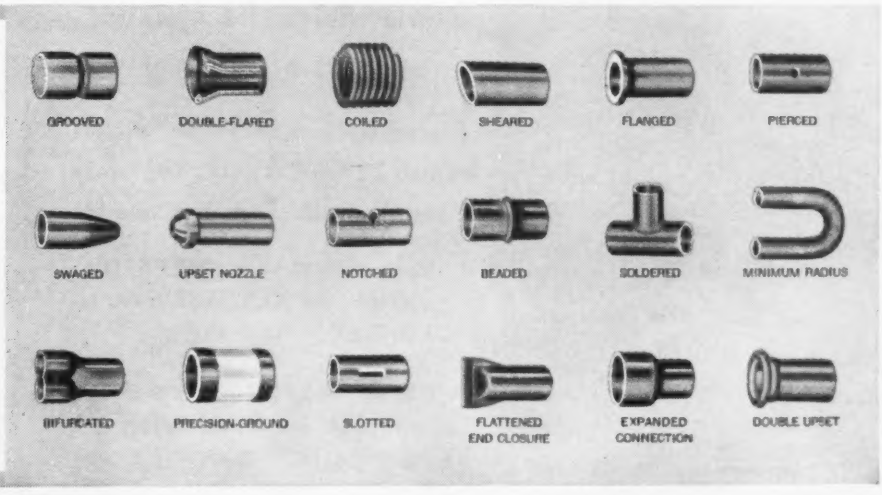
Bundy engineers and designers are backed by years of experience in the mass-fabrication of steel tubing. And they are available to you at any stage of product development for time- and money-saving suggestions. Their key: Bundyweld®!

Bundyweld steel tubing is double-walled, copper-brazed, leak-proof by test, with beveled edges to provide smooth inside and outside seams. The safety standard of the refrigeration industry, Bundyweld meets ASTM-254 and Gov't. Spec. MIL-T-3520, Type III.

So, when you want to talk tubing, talk to the leader—Bundy! Phone, write, or wire Bundy Tubing Company, Detroit 14, Michigan.



No matter what type of mass-fabrication you require, Bundyweld may be your answer. Shown here are just a few tubing operations designed and fabricated by Bundy—many for use in the refrigeration industry.



There's no substitute for the original

BUNDYWELD® TUBING

WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING • AFFILIATED PLANTS IN AUSTRALIA, BRAZIL, ENGLAND, FRANCE, GERMANY, ITALY, JAPAN

BUNDY TUBING COMPANY • DETROIT 14, MICH. • WINCHESTER, KY. • HOMETOWN, PA.

CANDIDATES FOR MEMBERSHIP

(*Continued from page* 75)

REGION IX

Idaho

GELLERT, N. H., JR., Pres., Hood Heating & Air Conditioning Co., Boise.

HOBSON, W. E., JR., Field Engr., Texas Instruments, Inc., M&C Div, Wichita.

Kansas

New Mexico

FAIGEN, BURTON,† Pres., Air Conditioning Equipment Co., Albuquerque.

LYON, C. L., Cons. Engr., Lyon Engineering, Albuquerque.

SOLTIS, C. W., Vice-Pres., Comfort Air Service, Albuquerque.

North Dakota

RITCHIE, W. L.,* Chief Plant Engr., American Hydrotherm Co., Minot.

REGION X

Arizona

ROBERTSON, H. A., Pres., Southern Arizona York Contracting Co., Tucson.

California

BURKE, V. J.,* Pres., Burke & Co., Los Angeles.

FORMBY, ROY, JR.,* Research & Dvlpt. Engr., Pacific Fruit Express Co., San Francisco.

JENKINS, D. C., Sales Engr., American-Standard, Industrial Div, Los Angeles.

MCELLIGOTT, R. W., Repr., 2 Slakey Bros., Sacramento.

MEIER, S. A., Sales Engr., American-Standard, Industrial Div, Los Angeles.

MIX, G. C., Sales Mgr., Torrington Mfg. Co., Western Div, Van Nuys.

MORSE, J. A., JR., Regional Engrg. Mgr., Carrier Corp., Los Angeles.

NAGL, M. A., Mech. Engr., Welton Becket, Los Angeles.

O'ROURKE, E. L., Sales Engr., American-Standard, Industrial Div, Los Angeles.

ROONEY, R. M.,* Assoc. Engr., Lockheed Missiles, Vandenberg Air Force Base.

SIEGEL, P. J., Vice-Pres. & Gen. Mgr., Master Fan Corp., Los Angeles.

WAALER, P. H., Sr. Engr., Daniel, Mann, Johnson & Mendenhall, Los Angeles.

WADA, KEYI,* Draftsman, Engr., Consulting Mech. Engrs. Bakersfield.

WINN, R. E., Mgr., Plbg. & Htg. Dept., Fiberglas Engineering & Supply Div of Owens-Corning, San Diego.

Oregon

PHILLIPS, W. C.,* Principal Engr., Cornell, Howland, Hayes & Merryfield, Corvallis.

Washington

LEACH, J. G., Sales Repr., Pacific Pumping Co., Seattle.

MCBETH, J. N., Sales Repr., Pacific Pumping Co., Seattle.

Canal Zone

LOHR, B. M., Mech. Engr., Panama Canal Co., Balboa.

FOREIGN

Australia

INGRAM, M. D., JR., Draftsman, Evans Deakin & Co. Ltd., Brisbane, Queensland.

MITCHELL, K. S.,* Exec. Engr., A.C.T. Engineering Co. Pty. Ltd. Earlwood, Sydney, N. S. W.

British West Indies

LEWIS, S. M., Mgr. & Engr., Lewis Refrigeration Sevice, Kingston, Jamaica.

India

BIJLANI, C. A., SR., Fellow, Central Government of India, Ajmer.

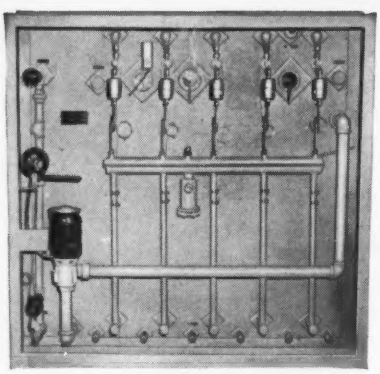
SCHNYDER, HANS, Mfg. Supt., Design & Devlpt. Engr., Voltas Ltd., Bombay.

Malaya

NGIM, K. J., Engr., General Electric Co. (Malaya) Ltd., Kuala Lompur.

The "King Zeero" Ice Building and Cooling System

☆ No Moving Parts ☆ No Mechanical Agitation ☆ Negligible Maintenance



"King Zeero's" NEW Combination
PURE WATER COOLER and ICE BUILDER
Front View

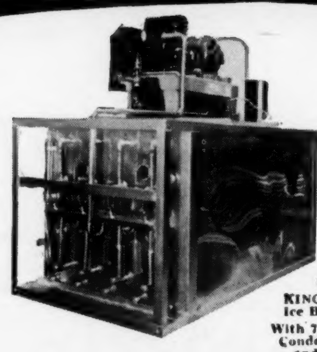
For INGREDIENT and WASH WATER APPLICATIONS
Provides a Clear Odorless. Palatable. Filtered Cold Water Supply

Patented Built-In Louvers provide Automatic Agitation without extra power

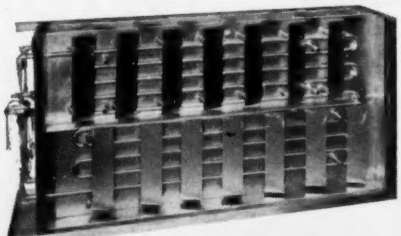
Stored Ice and Direct Expansion furnish 32°-34° circulating water for all product cooling needs.

Remember, the "King ZEERO" delivers the COLDEST water LONGER for less outlay.

THE KING ZEERO
May also be used with an AIR CONDITIONING UNIT



MODEL 4084
KING ZEERO
Ice Builder Cabinet
With 7½ H.P. Freon Condensing Unit and Controls



MODEL 2084 KING ZEERO ICE BUILDER CABINET
CROSS SECTION SHOWING COIL AND LOUVRE ARRANGEMENT

THE KING ZEERO COMPANY
4300-14 W. Montrose Ave.
Chicago 41, Ill.

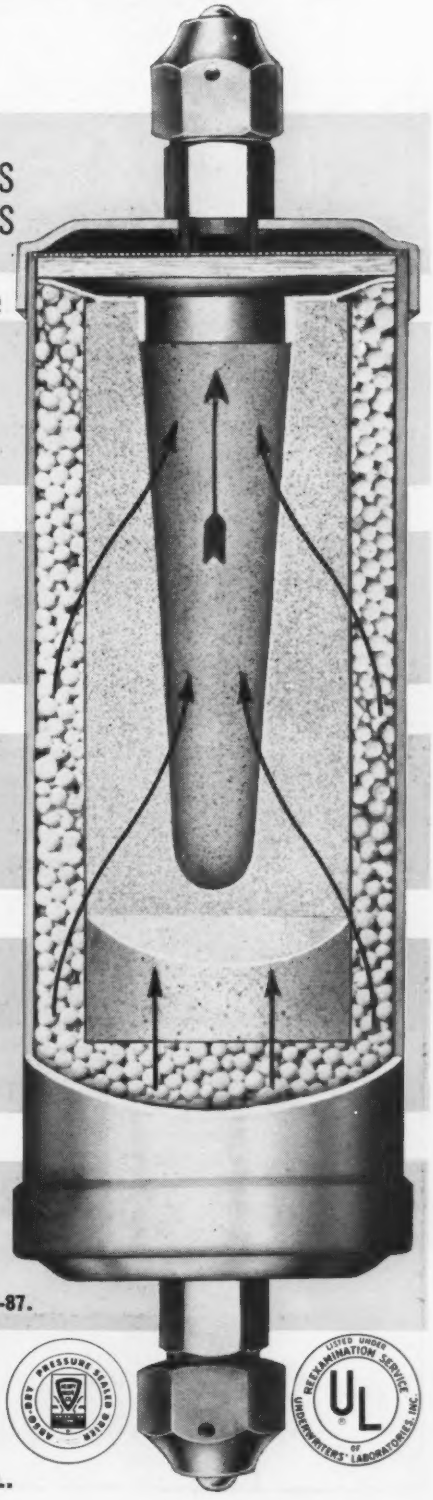
Manufacturers of Ice Builders - Ice Builder Cabinets - Ice Banks - Pure Water Coolers

HENRY VALVE CO.

CONTROLLING FLOW SINCE 1914

"DRI-COR"® the High Flow... High Drying Capacity... Acid Removing... Refrigerant Filter-Drier with Granular Desiccant and Advanced Design Molded Core

The only molded core made by ceramic bonding of highly efficient desiccant particles. All inert fillers are removed by ceramic fire completely activating the core. Permits maximum flow and depth filtration at minimum pressure drop. Dryness assured by Abso-Dry® pressure sealing and Brass Flare Nuts.



CAPACITY RANGE R-12 up to 20 TONS
R-22 up to 25 TONS

DRI-COR Advanced Molded Core

Design Provides Uniform Core Porosity
No Inactive Cement or Binder

DRI-COR Two Stage Drying

Progressive Filtration . . .
500 P.S.I. Working Pressure

DRI-COR Drying And Filtering

Properly Proportioned . . .
Complete range of sizes

DRI-COR Low Pressure Drop

Transverse Flow for Rapid
Moisture and Acid Adsorption

DRI-COR Pressure Sealed

Permits Continued Desiccant
Reactivation Prior to Use

Also Available in Replaceable Cartridge Types . . . Write for DRI-COR bulletin V-87.

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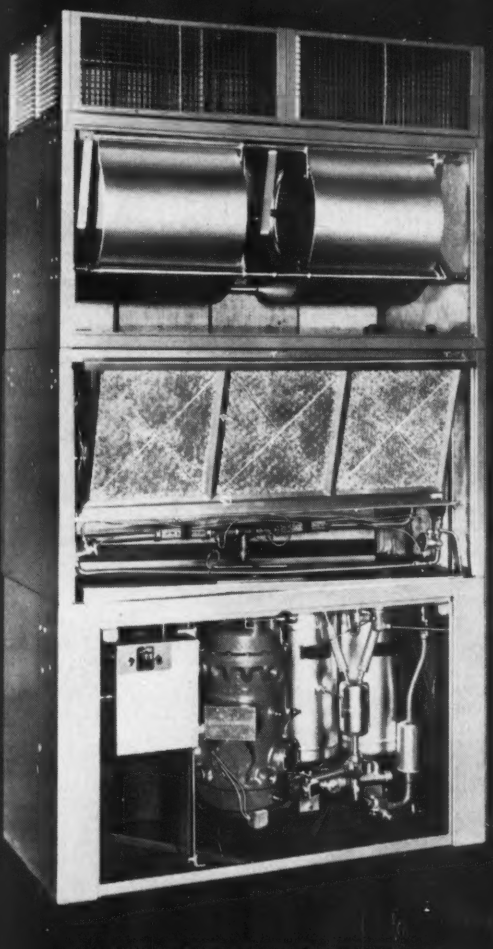
For Refrigeration, Air Conditioning and Industrial Applications

MELROSE PARK, ILLINOIS, U.S.A. CABLE: HEVALCO, MELROSE PARK, ILL.

WOLVERINE TUBE HELPS

CHRYSLER

"CREATE CLIMATE FOR LIVING WHEN NATURE DOESN'T"



CHRYSLER PACKAGED AIR CONDITIONER

Suction lines. Capillary tube. Light wall special temper tube. Finned tube and plain. All these Wolverine products have important places in the evaporative and condensing units which are the hearts of Chrysler air conditioning systems. You'll find Wolverine products in most Chrysler units.

Chrysler is famous for firsts in air conditioning research and development, just as Wolverine has paced the field in pioneering tubing ideas and products to serve the industry. Important Wolverine developments for all industries include Wolverine Trufin®, the integral finned tube; Wolverine Capilator®, the capillary tube for precision metering of liquids and gases, and light wall special temper tubing.

When you specify Wolverine seamless copper, copper alloy or aluminum tube–you are cashing in on the high quality and outstanding service that only experience can give. Write for complete information as to how Wolverine can help you. Do it now.

WOLVERINE TUBE
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PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA
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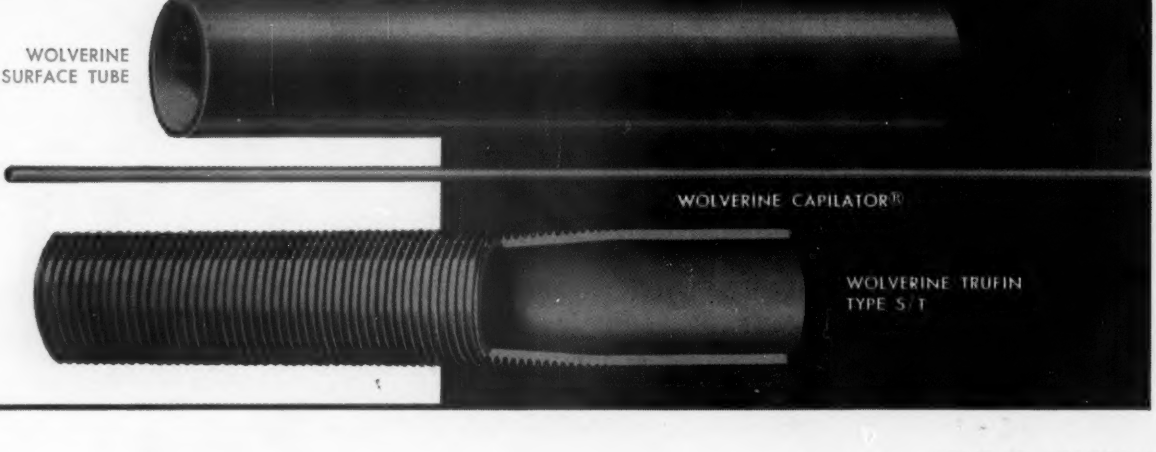


WOLVERINE CAPILATOR®

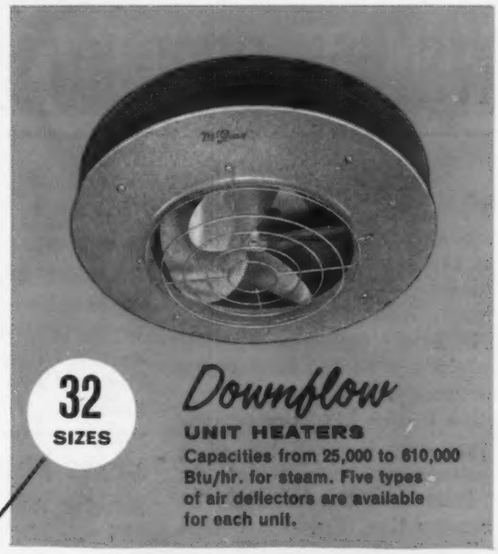
WOLVERINE TRUFIN
TYPE S/T

these outstanding

McQuay

Ripple-Fin

UNIT HEATERS...



MORE THAN MEET

EVERY REQUIREMENT

McQuay Unit Heaters have modern styling. The attractive cabinets are finished in neutral hammer enamel and blend well with all surroundings. They are available in an exceptionally wide range of sizes and capacities for either steam or hot water to enable you to meet the requirements of every job... old or new, large or small. McQuay Unit Heaters will solve any low cost heating problem anywhere with uniform and quiet delivery of heat, and with that extra efficiency afforded by Ripple-Fin coils. Years of experience and research provide the know-how for which McQuay is famous. For complete specifications, ask your nearest McQuay representative, or write McQuay, Inc., 1606 Broadway Street N. E., Minneapolis 13, Minnesota.

McQuay Means Quality

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

N E S W

MAKE THE SEASONS COME TO YOU

PARTS and PRODUCTS

CONDENSING UNITS

Seven new fractional hp condensing units, first in a line which will utilize recently developed, space-saving condenser design, have been introduced. Uniform in height and width, meassuring only 8⅞ x 13 in., they range from 1/6 through 1/3 hp.

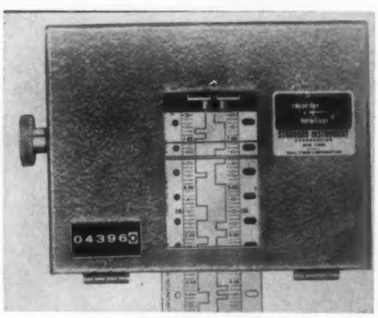
Reduction in size has been accomplished primarily through use of a smaller condenser with wider fin spacing. Instead of the usual six fin per in. construction, Free-Flo design has only three to the in. Efficiency is maintained by less restricted air circulation and reduced tendency for dust accumulation and subsequent clogging. A substantially heavier gauge steel has been used to give better heat transfer and additional strength to the individual fins.

Capacities of the five low temperature models range from 680 to 1450 Btu/hr and from 2000 to 2950 Btu/hr in the high temperature units.

Tecumseh Products Company, Tecumseh, Mich.

TIME RECORDER

Designed to record and compare productive time of plant and office equipment, the Two-Channel Time Recorder graphs simultaneously, on a single strip chart, operating patterns



of two machines, two functions of the same machine or any two processes. It may be connected to distinguish between actual productive time and non-productive idling time.

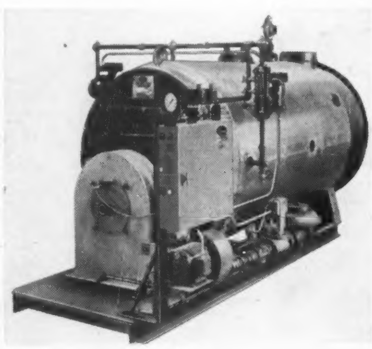
Featured on the instrument is a built-in Time Totalizer, a read-out counter which furnishes continuously a visual sum of productive time in hours and tenths or minutes and tenths. An access window permits making notations directly on the strip chart.

Operation is by means of a chronologically-printed strip chart which moves at a constant rate through the recorder. Two styli continuously scribe the tape, marking on-off operation of the machines to which they are wired. Standard chart roll speeds are one, four, twelve and sixty in./hr. Slower charts run as long as four months without change.

Standard Instrument Corporation, 657 Broadway, New York 12, N. Y.

3-PASS BOILERS

Rated at 80, 125, 150 and 200 hp at 125 psi, WP automatic 3-pass Scotch Marine boilers for manufactured, mixed, natural or LP gas are equipped with a newly designed burner cited



as providing quiet operation. Boilers are also available with oil or combination gas and oil burners. Combustion air for the gas-fired boilers is supplied by a blower which eliminates the need for anything but a short stub stack to remove flue products from the boiler room.

Eclipse Fuel Engineering Company, Boiler Div, Chattanooga, Tenn.

GAS LEAK DETECTOR

Extremely small leaks of compressed gas may be located with this detector, a high-viscosity liquid which forms bubbles when daubed on pipe joints where leakage is suspected. Leaving no deposit, harmless to skin and non-staining, the liquid can be used without danger of fire. Composition is non-freezing and is cited as functioning efficiently with any compressed gas.

Calgon Company, Hagan Ctr., Pittsburgh 30, Pa.

CENTRIFUGAL FAN

Designed for operation at 10,000 rpm, Model 6S is cited as being suitable for building into apparatus or installations requiring thorough ventilation or movement of air, such as in cooling electronic tubes. Capacities of the fan range from 96 cfm at 6 in. static pressure to 20 cfm at ten in. pressure.

Featured is extremely flexible housing, which can be rotated to change the angle of air discharge. Steel fan is directly connected to the motor.

Ilg Electric Ventilating Company, 2850 N. Pulaski Rd., Chicago 41, Ill.

BASEBOARD PANELS

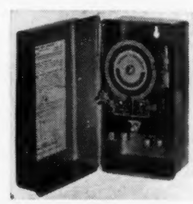
Constructed of durable cast iron and water-backed for efficient operation, Model 8 Radiantrim baseboard panel for installation under low windows, along glass walls and other height-restricted areas has been designed to match the appearance of the larger Model 10. Like the Model 10, it can be installed against a wall or recessed to the depth of the plaster.

Panels have rounded corners and come in two sizes, 12 and 24 in. Both 10 and 8-in. baseboards have a full line of matching accessories.

American Radiator & Standard Sanitary Corporation, Plumbing & Heating Div, 40 W. 40th St., New York 18, N. Y.

TIME CONTROL

For high-pressure steam systems, Model 1977SKV1 pulses open motorized valves to permit gradual entry of steam. Use of the control, which opens valves at a pulse a min, eliminates the need for modulating motor valves. Unit is a double-pole, double-throw switch, available with Skip-A-Day Control, which permits omission of operation on one or more days each week without altering the master program.



Tork Time Controls, Inc., Heating Controls Div, Mount Vernon, N. Y.

INSULATING FILL

Suitable for use with low temperature liquefied gases, Perlox, a low-density insulating fill formed from expanded silica aggregate, is cited as being safe for the majority of cryogenic applications, including insulating liquid oxygen and hydrogen.

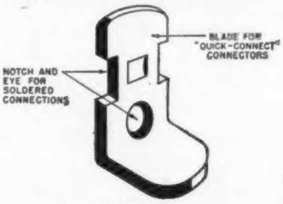
Completely inorganic, it is both physically and chemically stable and, because of its structure and powder form, provides little body for moisture pickup. When the material is settled in place, it has a density of only three lb/sq ft. Temperature limits

A FEW FACTS ABOUT MOTOR CAPACITOR TERMINALS

Contrary to a common belief shared by many users of specialty capacitors for a-c applications, all capacitors are *not* alike. Some brands have not changed in design or construction for years. Others make changes to keep up with competitive products. Sprague Electric, however, constantly improves its designs for maximum dependability and minimum cost.

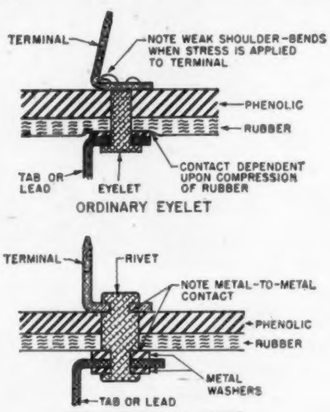
Although the terminal assembly is a relatively small part of the entire unit, it has often been the cause of capacitor failure. Here, Sprague has developed new, improved terminals which eliminate failures of this nature, reduce equipment manufacturers' assembly time, and make future servicing easier. Here are some of those recent improvements:

1. "UNIVERSAL" TERMINAL LUG



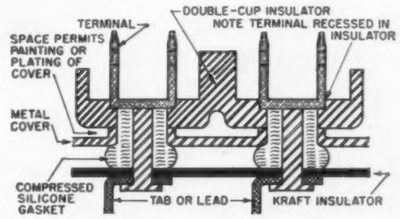
Single-blade or dual-blade, designed for use with "quick-connect" connectors. Also has notches and eyes for soldered connections—an important feature when "quick-connect" connectors are inadvertently destroyed by servicemen. Copied and imitated by others, universal terminal was originally designed by Sprague, is now patented by Sprague.

2. DOUBLE RIVET CONNECTION



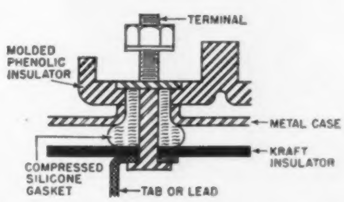
Unique new rivet design for positive metal-to-metal contact between rivet and terminal as well as between rivet and tab. Unlike ordinary eyelet where weak riveted shoulder will bend or break when terminal is pulled, as often happens when removing snug-fitting "quick-connect" connectors, Sprague rivet prevents arcing caused by loosened contact points. Patent pending on this unique design.

3. DOUBLE-CUP INSULATOR



New one-piece molded phenolic cups for increased rigidity and prevention of terminal rotation. Unlike ordinary single-cup construction, which permits accidental twisting of terminals, causing leads inside capacitor to "short" or break off, terminals in Sprague's new double-cup insulator cannot turn because of square recess in molding which accommodates base of terminal. Bottom of insulator has contoured shape which permits plating or painting of entire capacitor cover, in full compliance with Underwriters' Laboratories, Inc. requirements for outdoor applications. No hidden, unprotected areas, as with ordinary single-cup. Patent pending on this assembly.

4. STURDY STUD TERMINAL



Pull-proof, welded terminal assembly designed to take severe physical abuse. The first reliable stud terminal available on a-c specialty capacitors. Although superior in performance, new Sprague design actually costs less than any other stud-type terminal. Patent pending on this assembly.

For Engineering Bulletins or application assistance on Sprague's complete line of a-c specialty capacitors, write to Technical Literature Section, Sprague Electric Company, 383 Marshall Street, North Adams, Massachusetts.

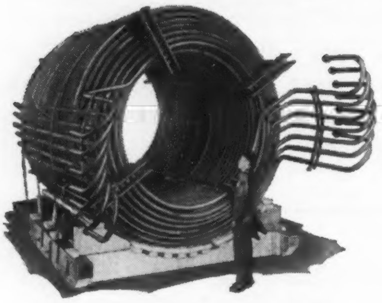
WORLD'S LARGEST MANUFACTURER OF CAPACITORS

SPRAGUE®

THE MARK OF RELIABILITY

REMPE
Heat Transfer Equipment

PIPE COILS



No Problem too Complicated for Rempe Engineers . . .

Complicated assemblies or production runs of Coils or Bends from any type of pipe or tubing can be designed to your requirements. Multiple spiral coil illustrated consists of seven separate circuits of carbon steel tube, electric welded at intermediate joints — Weight 22,000 lbs.

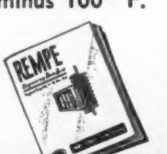
LARGE OR SMALL
WE MAKE THEM ALL

CASCADE CONDENSERS

Rempe

For Low Temperature Refrigeration Systems

Ideally suited for all low temperature work. Illustration shows shipment of 12"x60" Cascades—sizes available from 6" to 30" diameters. Refrigerant vapor condenses in shell. Internal fin coil carries a second refrigerant. Also suitable for low temperature Glycol chilling down to minus 100° F.



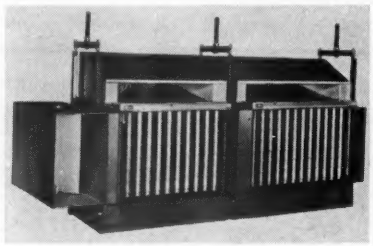
Engineering Data Book
Pipe Coil and Fin Coil Designs. Heat Transfer Coefficients. Get a copy for your library.

REMPE COMPANY
362 N. Sacramento Blvd. • Chicago 12, Ill

are from −450 to 1400 F. At −300 F it has a thermal conductivity of slightly less than 0.10 Btu in. per sq ft per F per hr.
Johns-Manville Corporation, 22 E. 40th St., New York 16, N. Y.

SECTIONAL FURNACES

Models with capacities up to 300,000 Btu/hr are included in this line of sectional gas duct furnaces, and can be close-coupled for any total capacity. Units are available with either



aluminized or stainless steel heat exchangers and may be used with all common gases. Stainless steel condensate shield assembly is available for applications where moisture is likely to form on inner surfaces of the heat exchanger tubes. Another accessory for air conditioning applications is a factory-built by-pass section with adjustable damper. When sought air delivery exceeds capacity of the duct furnaces, one or more by-pass sections may be installed as illustrated and the dampers adjusted for proper temperature rise.
Hastings Air Control, Inc., Omaha 5, Nebraska.

COOLING TOWER

Major design changes in this manufacturer's package water-cooling tower, Permatower, feature conversion of the water distribution system to the gravity flow method and inclusion of an automatic bleed-off arrangement as standard equipment.

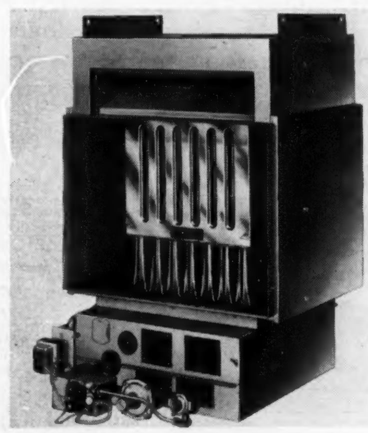
Water proof laminated wood panels with fiber-reinforced resin coatings are used for casing and basing and all metal components are hot dip galvanized after fabrication for max corrosion resistance.

All towers are shipped completely assembled. Nominal capacities of the line range from five to eighty ton.
Marley Company, 222 W. Gregory Blvd., Kansas City 14, Mo.

DUCT FURNACES

Installation of duct furnaces downstream of cooling surface in air conditioning systems is cited as being practical with this new line of furnaces. AGA approved for this application when equipped with optional stainless steel drain pan, units are offered in six sizes ranging from 75,000 to 300,000 Btu/hr input. All models are AGA approved for use on natural mixed or LP gases. Controls are designed for 24-volt service and can be converted to 115 and 230 volt operation by means of an optional transformer.

Offered as standard equipment, a built-in by-pass eliminates need for a separate by-pass duct to handle the greater cfm required by systems



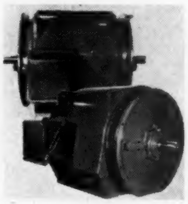
which provide cooling. As a result, all air passes through the duct furnace, reducing internal static pressure. All burners are stainless steel, heat exchangers are either stainless or aluminized steel and casings are aluminized steel. Furnaces may be installed side by side in unlimited numbers within any one of three height groupings.
Modine Manufacturing Company, 5200 DeKoven Ave., Racine, Wisc.

HIGH PRESSURE MOTORS

Two special electric motors for high pressure pump applications have been introduced, featuring mounting flanges and shaft extensions on both ends to which the pumps will be mounted directly. Each of the mechanically modified motors is rated

at 350 hp, 1160 rpm, and designed for operation on three-phase, 60-cycle, 440-volt systems.

Incorporated in the motor enclosures is a compact, standard frame design also used for doubly-protected type RP polyphase squirrel-cage motors. These completely drip-proof enclosures have ventilating openings so located and shielded as to provide essentially splash-proof protection.



Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis 14, Mo.

ORIFICE VALVE

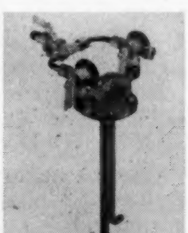
Adjustable to permit accurate balancing of steam and hot water systems, the R-105 is available in ½, ¾ and 1-in. sizes in angle, straight or corner patterns. A stop screw in the valve stem provides a full range of orifice adjustments without the necessity of shutting down the system or breaking the union connection. Such adjustments are accomplished by a modulating cone which may be set to increase or decrease flow. Positive shut off is possible at all times without disrupting the orifice setting.

On steam systems, the valve is adjustable from ten to 100 sq ft of radiation. On hot water jobs, flow through the valve at any given pressure can be adjusted to assure proper flow through the heating element.

Marsh Instrument Company, Div of Colorado Oil and Gas Corporation, Skokie, Ill.

PITOT TUBE

Designed to solve the problem of measuring air or gas velocity and pressure in dry dust or dirt laden environments, the Purge Clean-Out Pitot Tube features a blow-out system utilizing compressed air to clear its total pressure probe and static pressure element of obstructions. A three-way valve prevents direction of blowout pressure toward the gauge or manometer. Unit is constructed of brass and stainless steel and is silver soldered for operation in temperatures to 800 F.



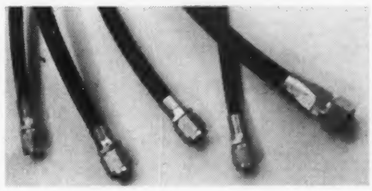
All tubing and piping, including one compressed air connection, are incorporated in a single assembly. Five tube sizes are available; nominal insertion lengths of 3, 6, 12, 18 and 24 in. are suitable for ducts with 6, 12, 24, 36 and 48-in. diam, respectively.

F. W. Dwyer Manufacturing Company, P. O. Box 373, Michigan City, Indiana.

NYLON PRESSURE HOSE

Hose with a specially formulated nylon inner tube reinforced with high tensile strength yarn has been introduced for use in refrigeration applications, among others. Designated Nylaflow, it is cited as being one-fifth the weight and having less than one-half the wall thickness of rubber hose with equivalent burst strength.

On flex-impulse testing, hose with a rated max operating pressure of 1250 psi, when pressure pulsed to



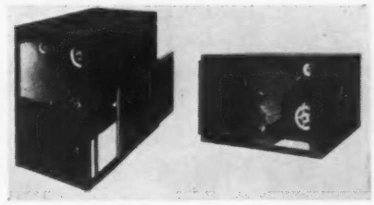
2500 psi, flexed 1,171,000 times and withstood 96,000 impulse cycles without failure. Hose is cited as being unaffected by flammable and non-flammable hydraulic fluids, having low refrigerant permeability and excellent resistance to caustics and almost all organic solvents. It is non-toxic, noncorrosive, fungus resistant and will not become brittle in storage. Flexibility and toughness are cited as being retained in temperatures as low as −65 F. Hose can operate constantly in temperatures to 200 F and intermittently in temperatures as high as 300 F. Two types are available presently with burst pressure ratings of 1250 and 2000 psi. Inside diam are ⅛, 3/16, ¼, 5/16, ⅜, ½ and ⅝ in.

Polymer Corporation of Pennsylvania, 2140 Fairmont Ave., Reading, Pa.

BLOWER-COIL UNIT

Available in three sizes, 34,800, 45,000 and 56,600 Btu/hr net cooling capacity for use, respectively, with three, four and five-hp air-cooled condensing units, Luxaire Series BC blower and cooling coil unit provides flexibility for all installations with either horizontal or vertical discharge and end, bottom or side air intake.

For usual horizontal installations, the unit can be connected with ducts to air diffusers for multiple room conditioning. Where air is to be taken directly from or discharged directly into the conditioned area, intake and discharge plenum grilles are offered as accessories. A new feature is adaptability for vertical discharge, made possible by changing the position of the drain pan. In the vertical position, the unit can be placed next



to a forced air furnace and connected into the same duct system for year-round air conditioning.

At right, in the illustration, the unit is shown as shipped from the factory, set up for horizontal installation and ready for connection to ducts. At left, the same unit is shown converted for vertical discharge with side air intake.

C. A. Olsen Manufacturing Company, Elyria, Ohio.

HUMIDIFIER

Stainless steel vaporizing chamber, safety pilot, low voltage wiring, fan interlocking, hermetic float control, humidistat and limit control are features of the Velair humidfier. Gas-fired, the unit can be installed in two hours on any forced air heating sys-

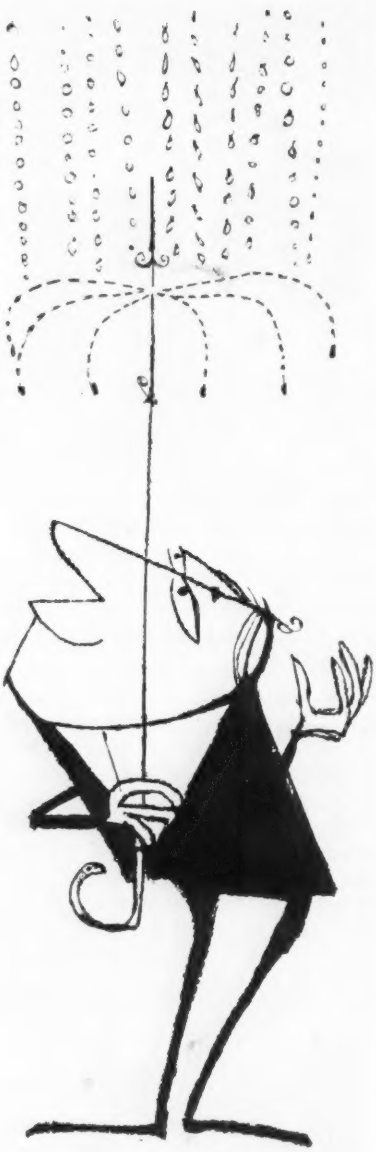
tem, vaporizes five lb of water and uses seven cu ft of gas per hr.

Southern Manufacturing Engineers, P. O. Box 1350, Hattiesburg, Miss.

ELECTRIC HEATERS

Supplementing its line of steam, hot water and gas-fired unit heaters, this manufacturer announces the addition of seven electric unit heaters, with capacities ranging from 5 to 25 kw and models available for 208, 240, 277 and 480 volt.

Heating elements of the units consist of steel fins bonded to steel tubes



Micromet® Plates form an invisible shield

Yes, Micromet Plates really protect a cooling water system. Used in a plastic mesh bag placed in the sump or hung in the recirculating water, one charge will protect most systems against scale and corrosion for six months. Low cost and easy to use, Micromet Plates are recommended by leading equipment manufacturers.

Micromet Plates—another Quality Calgon® Product available from your Refrigeration Wholesaler. Ask him about all the Calgon Products.

For free booklet on how to solve water problems, write:

CALGON COMPANY
HAGAN BUILDING, PITTSBURGH 30, PA.

DIVISION OF **HAGAN**
CHEMICALS & CONTROLS, INC.

that encase nichrome wires embedded in magnesium-oxide dielectric. A built-in limit control prevents overheating. Motors are suspended resiliently from a built-in safety fan guard mounted on the rear of the casing. Units may be suspended from the ceiling or from a wall by means of an optional bracket.
Modine Manufacturing Company, 1500 DeKoven Ave., Racine, Wisc.

REMOTE SYSTEMS

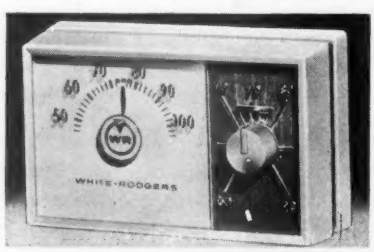
Remote air conditioning systems for residential installation may be combined with furnaces having capacities of 80,000, 85,000, 110,000, 140,000 and 170,000 Btu to provide a complete line of air conditioning systems for most residential needs. Air conditioners are available in two, three, three and one-half, four and five-ton models. Heat extraction at ambient temperature of 95 F is 22,500, 35,300, 41,500, 47,000 and 59,100 Btu/hr, respectively.

Featured on the air-cooled condenser are a high capacity centrifugal blower, extra large condenser coils and weather-resistant, heavy-gauge steel case. Cooling coils are available for existing ducts of horizontal furnace systems.
Pioneer Manufacturing Company, 3131 San Fernando Rd., Los Angeles 65, Calif.

THERMOSTATS

Offered in heating, cooling and heating-cooling types, D'Luxline thermostats have a range of 55 to 90 F, heating differential of ½ to 1½ deg and cooling differential of 1 to 2 deg.

Built into the wall mounting plate is a Level-Bubble, to assure level mounting for exact calibration. Also



incorporated in the line are sealed mercury contacts, for protection against corrosion, dirt and dust.
White-Rodgers Company, 1209 Cass Ave., St. Louis 6, Mo.

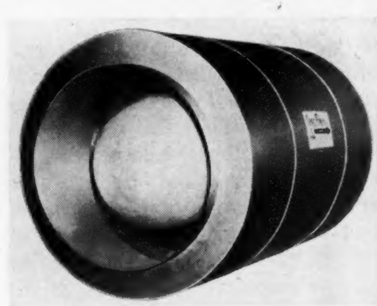
REVERSING VALVE

For heat pump application, this valve is of hermetically sealed construction and is actuated by a three-way solenoid operated pilot valve that may be removed easily from the main valve body when necessary. In order to minimize wear encountered in slide valve construction with metal-to-metal seating, the valve is provided with synthetic seats.

Available in all standard voltages normally supplied in Type 10 solenoid valves, the reversing valve has a mean operating pressure differential of 300 psi at 85% of rated voltage. Three different sizes of valves provide a wide range of capacities for Refrigerants 12, 22 and 500.
Sporlan Valve Company, 7525 Sussex Ave., St. Louis 17, Mo.

ROUND SILENCER

Round design of the Conic-Flow Silencer is cited as increasing the overall noise reduction of the unit with lower pressure drop than in previous



units. This is accomplished by use of a new airflow configuration, offering a bell-mouth entrance for min entrance loss and a solid nose entrance for max noise reflection. Unit has been designed for use in high pressure ventilating systems.
Industrial Acoustics Company, Inc., 341 Jackson Ave., New York 54, N.Y.

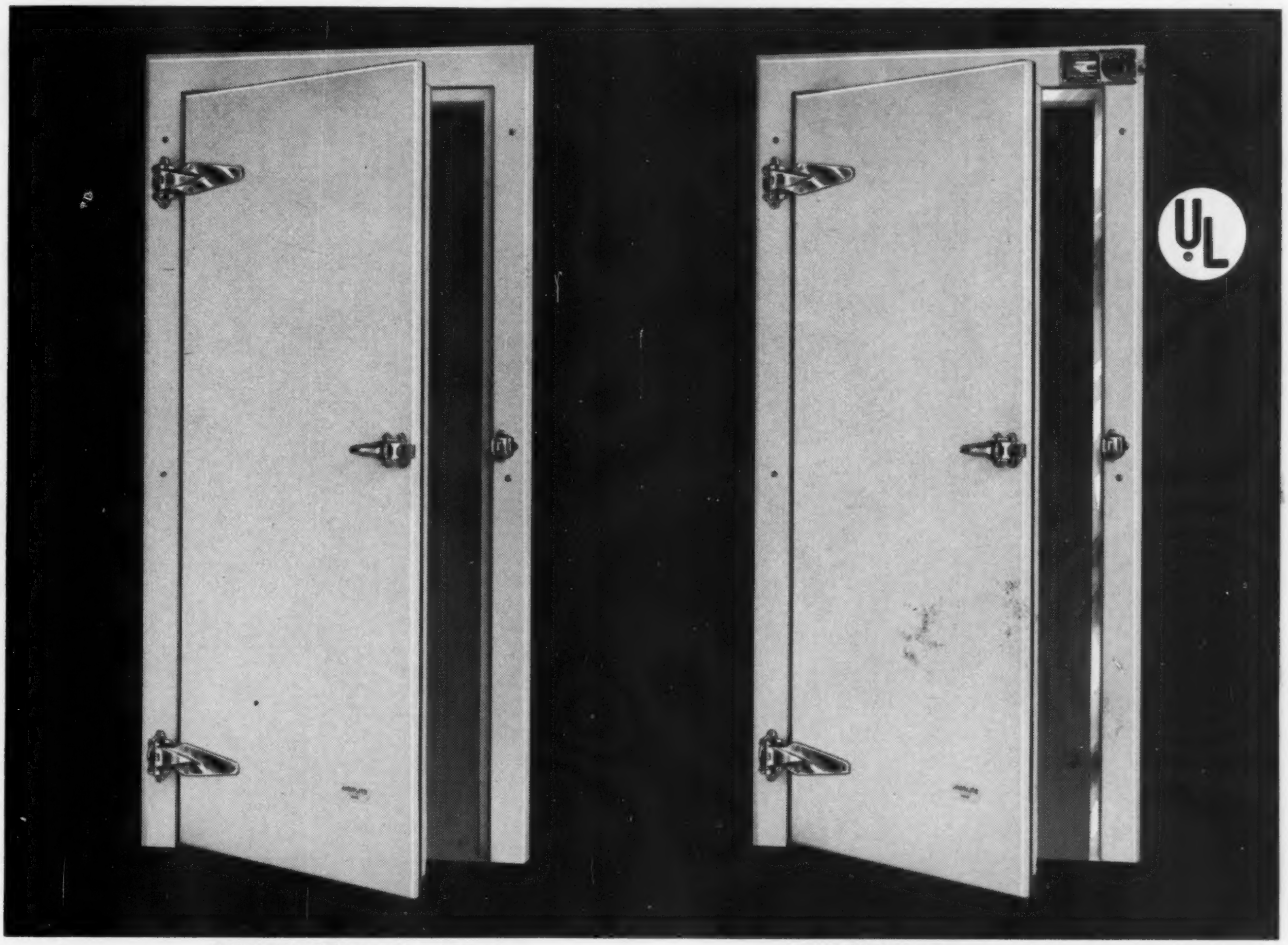
GAS-FIRED BOILER

Featuring 145,000 Btu/hr per burner for natural, mixed and manufactured gases, the G-60 boiler is available with dual gas equipment for natural and propane gases. Designed with all major components under the jacket enclosure, it has a compact appearance with a low overall height of 66⅛ in. for all models.

Its cast iron base serves as a support for the boiler sections and burners. Burners and mixing tubes are placed inside the boiler base and rigidly supported at the correct height. Main gas valve and control piping are sub-assembled at the factory. Multiple section design permits exact sizing for a wide range of installations, providing inputs between 725,000 and 5,800,000 Btu/hr.
American Radiator & Standard Sanitary Corporation, Plumbing & Heating Div, 40 W. 40th St., New York 18, N. Y.

NEW FOR COOLER AND FREEZER ROOMS:

Lightweight, Colorful JAMOLITE® Plastic Doors



JAMOLITE Cooler Door

JAMOLITE Freezer Door
with Jamison Frostop®

Lightweight: Weight is 1/5 of metal clad cold storage doors.	**4" Thickness:** Cooler and Freezer doors are both 4" thick.	Impervious to moisture and vapor—easy to keep clean.	Colorful JAMOLITE doors come in gleaming white and four colors.	Frostop prevents ice formation at area of gasket contact.

● THE JAMOLITE DOOR is a completely new development in cold storage doors for the Food Service Industry. In hotels, restaurants and institutions JAMOLITE Doors are transforming interiors with new brightness and color.

Both cooler and freezer doors are flush-fitting and only 4" thick with new lightweight framing. Foamed-in-place polyurethane plastic provides highly efficient insulation, is permanently bonded to rigid fiber glass shell. Installation details for each door are practically identical.

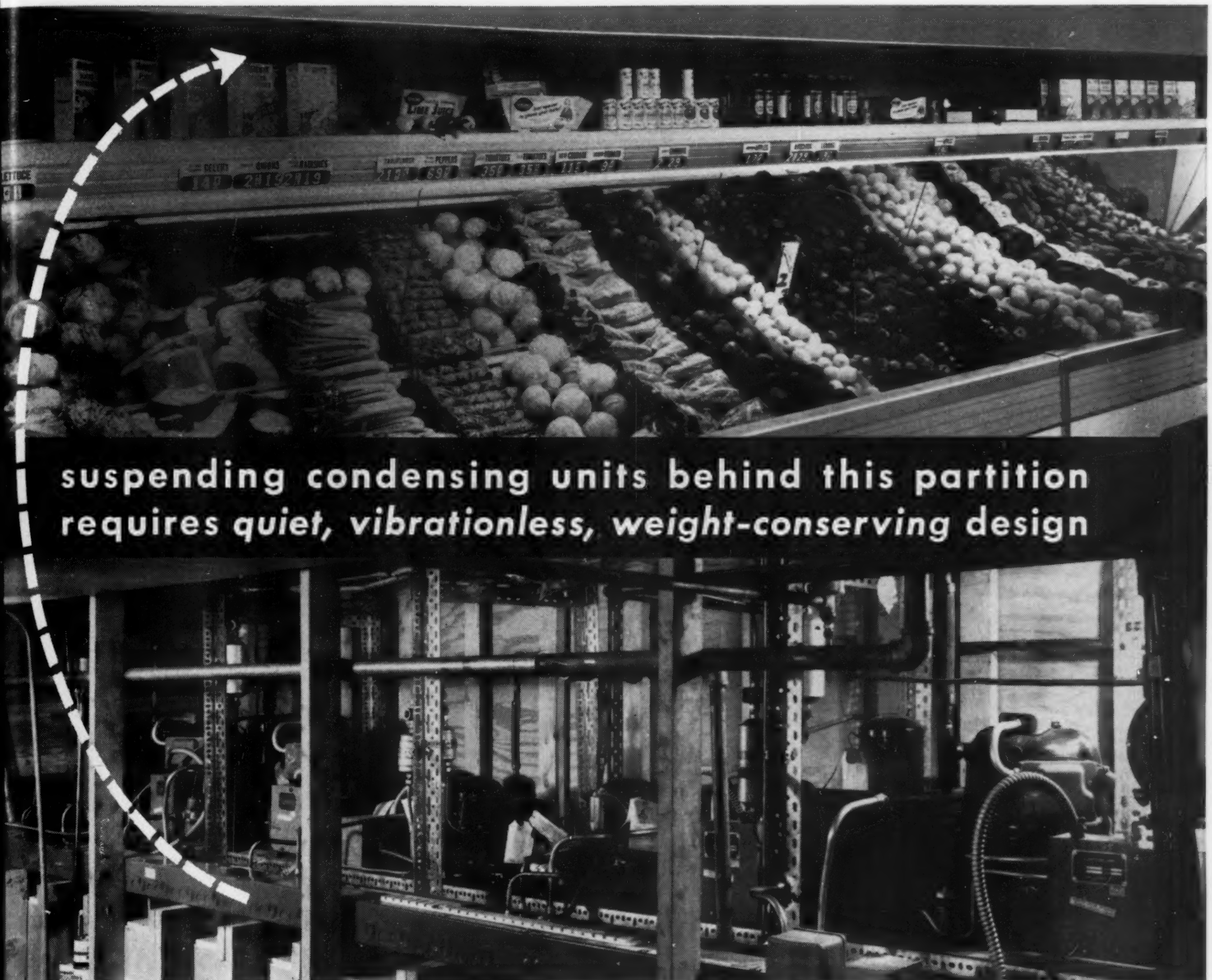
Complete data on new, lower-cost JAMOLITE is available in Sweet's; or write today for Catalog FS to Jamison Cold Storage Door Co., Hagerstown, Md.

*Jamison Trademark

JAMISON
COLD STORAGE DOORS

HAVE YOU SEEN WHAT TECUMSEH'S DOING

Nobody disputes the fact that the Tecumseh name has been prominent throughout the history of modern refrigeration and air conditioning. More than forty million Tecumseh compressors are currently in service around the world. Their extremely low percentage of field failures is proof of their dependable performance. While it is true that this record has been established largely outside the commercial refrigeration market, it is also true that the same dependability, the same design improvements, and the same production efficiencies, are in every instance incorporated into the Tecumseh commercial product line. These compressors and condensing units now meet all popular requirements.



IN COMMERCIAL REFRIGERATION THESE DAYS?

Typical of the installation flexibility possible with Tecumseh, the water cooled units pictured above have been mounted directly over a 12-foot produce case. This positioning alone points up three major design advantages; *ultra-quiet* . . . necessary in being located so close to customer traffic below, *vibration-free* . . . to prevent "chatter" transmission to the non-supporting partition built around the units, and *low weight factor* . . . permitting the units to be suspended from the ceiling. Along with conserving floor space in the installation of remote condensing units, the operating efficiency of these Tecumseh hermetics is second to none. These five units—ranging in size from ¾ to 3 H.P.—have supplied the varying refrigeration requirements for the produce case mentioned, a 3-door upright ice cream cabinet, an 11-door upright frozen food cabinet, an 8-door upright beverage case, and a 30′ open air curtain case . . . *without a single service call required.* Consult your local contractor or Tecumseh wholesaler for complete information on the entire *new* Tecumseh commercial line.

forty million compressors in the field

TECUMSEH PRODUCTS COMPANY

MARION, OHIO
TECUMSEH, MICHIGAN

FOREIGN OPERATIONS DIVISION: Tecumseh, Michigan

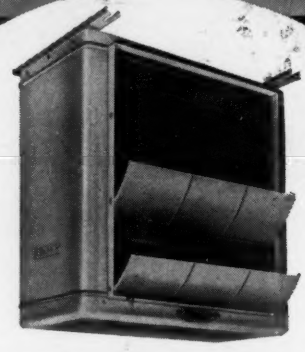
CANADA: Tecumseh Products of Canada, Limited, 1667 Dundas St., London, Ont.

the companion to Thermobank...

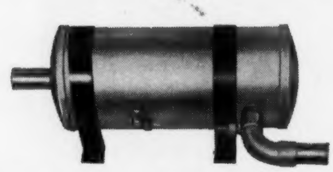
KRAMER THAW® SYSTEM

A NEW AUTOMATIC HOT GAS DEFROST SYSTEM

for applications where
LOW FIRST COST
is the major consideration



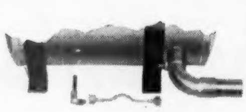
One fan evaporator with heat exchanger



Metering accumulator with brackets

If low first cost is the major factor, the new Kramer THAW SYSTEM offers more than any competitive system. (For sharp freezing loads, or where compressor is outdoors, Thermobank is recommended.)

- No compressor overloading with hold-back valve.
- Faster defrosting because more heat is available.
- Positively cuts liquid return to the compressor.
- Has the largest liquid accumulator.
- Foolproof metering device.
- No clogging with removable strainer.
- Oil problems eliminated by gravity drain.
- No unnecessary defrost cycles.
- Heated copper drain pan.
- Double pan to protect heating coil.
- Aluminum casing on evaporator.



Removable Strainer

Timer

Hot Gas Solenoid Valve

Hold-Back Valve

Hot Gas Strainer

Check Valve

Write for Catalog T-480

KRAMER TRENTON CO., Trenton 5, N. J.

47 YEARS OF CONTINUOUS ACHIEVEMENT IN HEAT TRANSFER

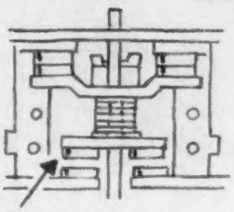
Economical, Service-free RBM SERIES 128000

POTENTIAL TYPE MOTOR STARTING RELAY

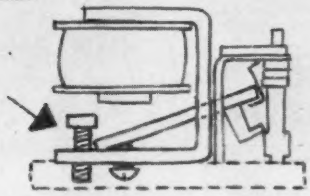
A highly efficient, dependable relay for starting single phase capacitor type motors, where use of centrifugal switch is impractical. Normally closed contacts disconnect start capacitor from circuit at desired switching speed. Standard contact arrangement is single pole normally closed. Listed by U/L File No. SA 1984.

MEETS STRINGENT REQUIREMENTS OF COMPRESSOR, MOTOR, PUMP, AIR CONDITIONING MANUFACTURERS

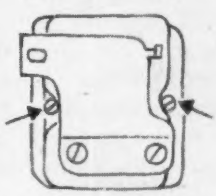
BENEFITS



EXTRA NORMALLY OPEN CONTACTS (SPDB) AVAILABLE FOR SEQUENCE STARTING

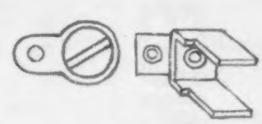


ADJUSTMENT BY "FLUX SHUNT" IN MAGNETIC CIRCUIT



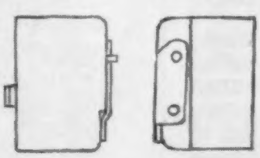
COVER HELD FIRMLY BY 2 SCREWS

NO CURRENT CARRYING RIVETS IN CONTACT CIRCUIT



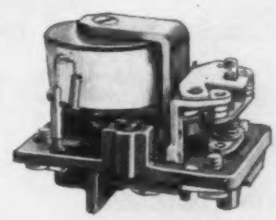
AVAILABLE WITH SCREW OR QUICK CONNECT TERMINALS

LARGE DOUBLE BREAK CONTACTS. POSITIVE BALANCED HAMMER BLOW ACTION



VARIETY OF MOUNTING BRACKETS AVAILABLE

GENERAL PURPOSE SHUNT TYPE RELAY SERIES 129000



INCORPORATES ALL 128000 FEATURES, EXCEPT OPERATING COILS ARE DESIGNED FOR STANDARD COMMERCIAL VOLTAGES. (OTHER COILS AVAILABLE FOR SPECIAL APPLICATION). CONTACT RATINGS 18 AMP AT 250 V. OR 1 H.P.-125 V. SINGLE PHASE; 2 H.P.-250 V. SINGLE PHASE. LISTED BY U/L FILE NO. E-12139.

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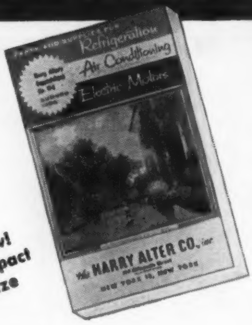

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- Refrigeration
- Electric Motors

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Applications

TWO 150-HP UNITS UTILIZED FOR COURTHOUSE AIR CONDITIONING

Lane County Courthouse, in Eugene, Ore., is a 150-ft square, four-story and basement structure. Basement is completely below grade, first floor wall is concrete with a rough stone facing and the second, third and fourth floor walls are constructed of glass block from floor to ceiling. Major heat loss areas are the perimeter offices and roof, and interior spaces require ventilation and cooling the year around because of the large amount of artificial lighting used and high occupancy.

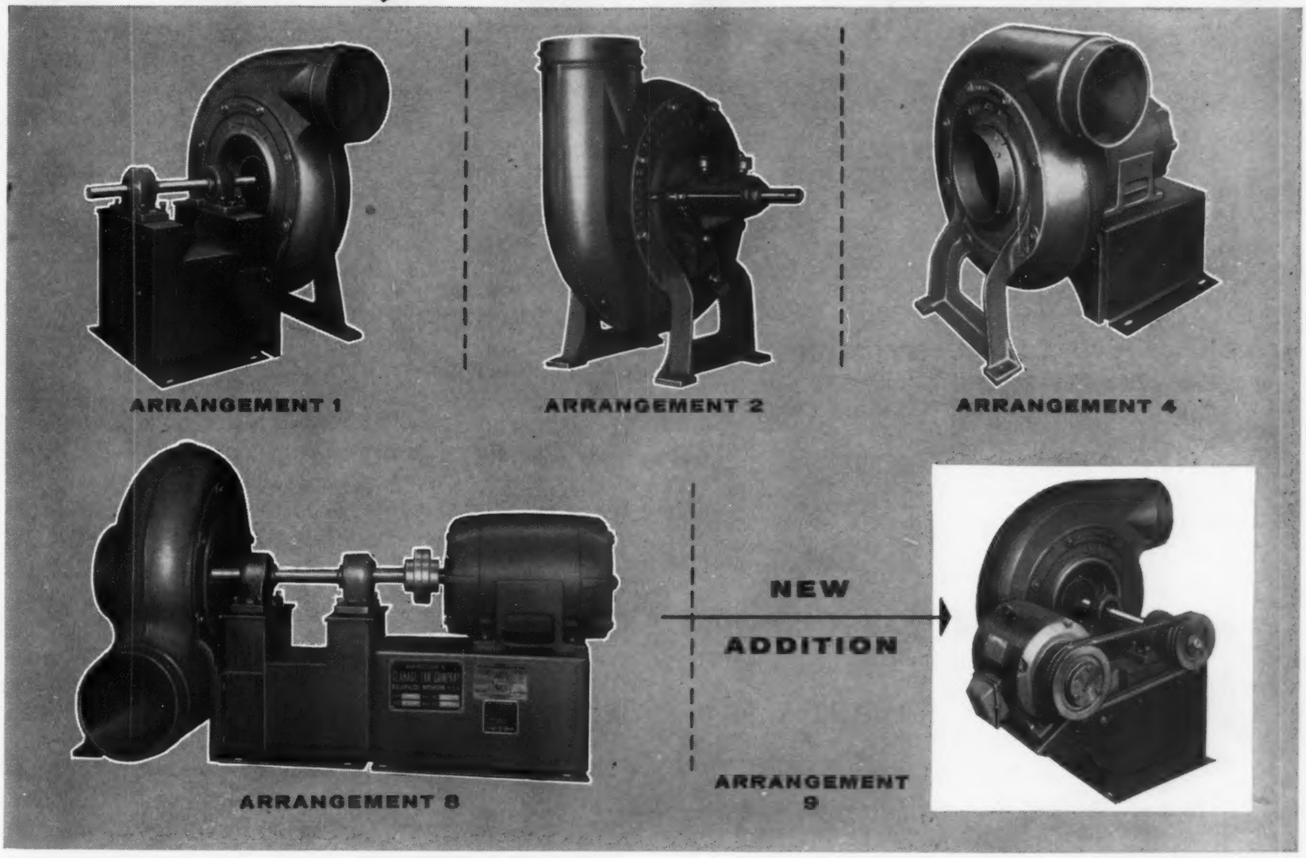
Air conditioning is provided by a central chilled water system utilizing two 150-hp Trane Hermetic CenTraVacs, located in the basement, and a cooling tower on the roof. The various spaces are heated, cooled and ventilated by 71 forced air units installed in a plenum space over and surrounding each floor. Plenums project several feet beyond the glass block and window line, to facilitate intake of outside air into the units by means of grilles located on the projecting soffit. Aluminum louvers on the building's exterior provide shading for from 12½ to 56½% of the exposed face, resulting in reduction of cooling load during the summer months.

Air to each space is either warmed or cooled by warm or chilled water from the CenTraVac circulating through coils in each air handling unit. The warm water side is also connected to central steam mains through a steam-to-water converter. Because of the high cooling load in the interior space when the building is fully occupied, exterior rooms can be heated with the excess heat drawn from the interior spaces. Steam-to-water converter is used for quick pickup when the cooling load is low. A two-pipe system of chilled water and a two-pipe system of warm water distribute the media throughout the building. Coils in the air handling units are controlled by means of three-way modulating valves which pass water to the coils according to demand, diverting the balance into return mains.

All controls are pneumatic, with a master control panel located in the basement equipment room. Units may be operated automatically or manually, or can be turned off at the panel.

CHURCH TO BE RADIANT HEATED

St. Sebastian Church near Pittsburgh, Pa., one of the country's newest churches, will be heated by a wrought iron radiant heating system, designed to operate when outdoor temperature is as low as zero F. Water will be heated to 100-140 F by a boiler located in the basement at the sacristy end of the church and will circulate through a network of wrought iron pipe embedded in the main church



Presenting... the new line of CLARAGE Type CI Exhausters

Volumes to 3800 CFM, pressures to 18″, temperatures to 750°F., six sizes, three wheel types, five arrangements as shown above, adjustable to any of the eight standard air discharge directions.

Result: fan equipment uniquely well suited to nearly every service imaginable. The uncomplicated, heavy construction, featuring cast iron housings and sideplates, makes the Type CI the natural selection for such severe applications as exhausting from grinding, woodworking, and other machines . . . conveying materials ranging from fibers to grains . . . removing smoke and fumes . . . furnishing industrial process air . . . handling chemical and hot gases.

Write for new Catalog 707 containing performance tables, dimensions, and system data. Get acquainted with the advantages you'll enjoy by choosing Clarage Type CI Fans for your next requirements. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

Dependable equipment for making air your servant

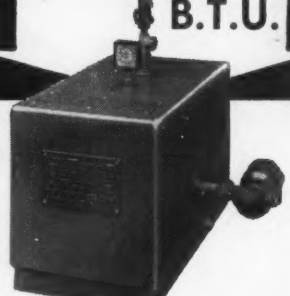
CLARAGE FAN COMPANY

Kalamazoo, Michigan

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

ELECTRIC HOT WATER HEAT

TO 2,000,000 B.T.U.



- 40,948 B.T.U. to 2,000,000 B.T.U. Output.
- All units meet the requirements of the ASME Boiler and Pressure Vessel Code.

PRECISION Electric HOT WATER HEATING BOILER

- **Complete unit ready for installation** with circulating hot water system and water chiller for year-round air-conditioning.
- **Conversion easily accomplished** where other type fuels now used. Suited for homes, churches, apartments, hotels, motels, hospitals, commercial buildings, swimming pools, snow melting and domestic hot water. Temperature Range 60 to 250 degrees.
- **Every unit tested and inspected.**

Write for color brochure and prices.

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Nashville 7, Tennessee

No ducts! No noise! No chimney! No odors! No flame!

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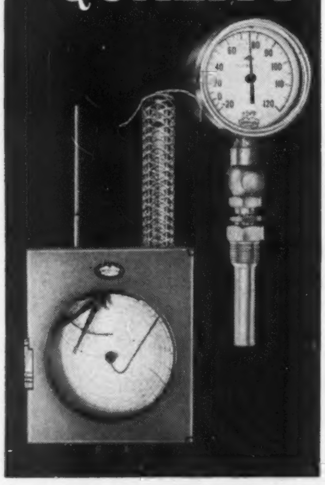

Say the word *"thermometer."* Chances are that the next name you think of is WEKSLER.

Engineering and product excellence is a tradition at Weksler, and the proof is in the reliable performance of over a million Weksler Instruments in every part of the world.

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Thermo-hygrographs in 8", 10", 12" chart sizes.
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floor. Heat will radiate to the surface, where rays will be absorbed and converted to heat energy. Anticipated output of approximately 640,000 Btu will represent 70% of required building heat. The additional 30% will originate from a supplementary forced air heating system. Heat output is based on 140 F max average water temperature and a radiant slab output of 60 Btu/sq ft. As outdoor temperature increases, water temperature modulates downward. 4-D wrought iron pipe used for the system was manufactured by A. M. Byers Company.

AIR CONDITIONING AIDS PHARMACEUTICALS PRODUCTION

Temperature and humidity play an important role in processing and production of coated tablets and must be taken into consideration when tablets are manufactured during warm weather. Warren-Teed Company, an Ohio manufacturer of pharmaceutical products, found that many of their coated tablets could be processed more easily during the cooler months of the year, and that different processing areas, located on the same floor, required individual temperature and humidity control.

Designed to meet these needs was an installation totalling 63 ton of cooling, using Armstrong three and five-ton air-cooled condensing sections, located on the roof of the building. Each unit is connected to a horizontal flow, independent evaporator to provide each processing area with controlled temperature and humidity. These Armstrong 42-R9 three and five-ton evaporators contain their own blowers.

MOBILE ENVIRONMENTAL UNIT TESTS MISSILE PARTS

Withstanding almost any ground weather while generating extreme environments of its own, a climate simulator delivered to White Sands Proving Grounds by Tenney Engineering, Inc., is housed in a 46-ft semi-trailer and can be moved to any point accessible to the vehicle, for testing missile parts on the launch pad. It is cited as being unaffected by outside temperatures from –5 to 115 F, rainfall of two in./hr, winds up to 75 mph or solar radiation of 400 Btu/sq ft/hr. Conditions the unit is capable of creating include: temperatures of –85 to 200 F, relative humidity of 20 to 100% and air flow of 600 to 6000 cfm. Unit is self-contained with its own 400 kv diesel electric generator.

CHAPTERS REGIONAL COMMITTEE

MEETINGS AHEAD

REGION I, Boston Chapter (Boston), Oct. 10-11
REGION III, Richmond Chapter (Williamsburg), Oct. 19-20
REGION IV, Atlanta Chapter (Atlanta), Oct. 19-20
REGION V, Central Indiana Chapter (Indianapolis), Oct. 24
REGION VI, Iowa Chapter (Des Moines), Nov. 2
REGION VII, Kansas City Chapter (Kansas City), Nov. 3

New low cost comfort cooling with natural Gas engines by Caterpillar

New high compression gas engines produced by Caterpillar can now provide comfortable, dependable air conditioning at a fraction of the cost of competitive fuel systems.

Couple the economic advantage of gas as a fuel with the built-in economy of the new Cat Natural Gas Engine, and you provide your clients with long-life, trouble-free cooling at operating costs that can't be beat.

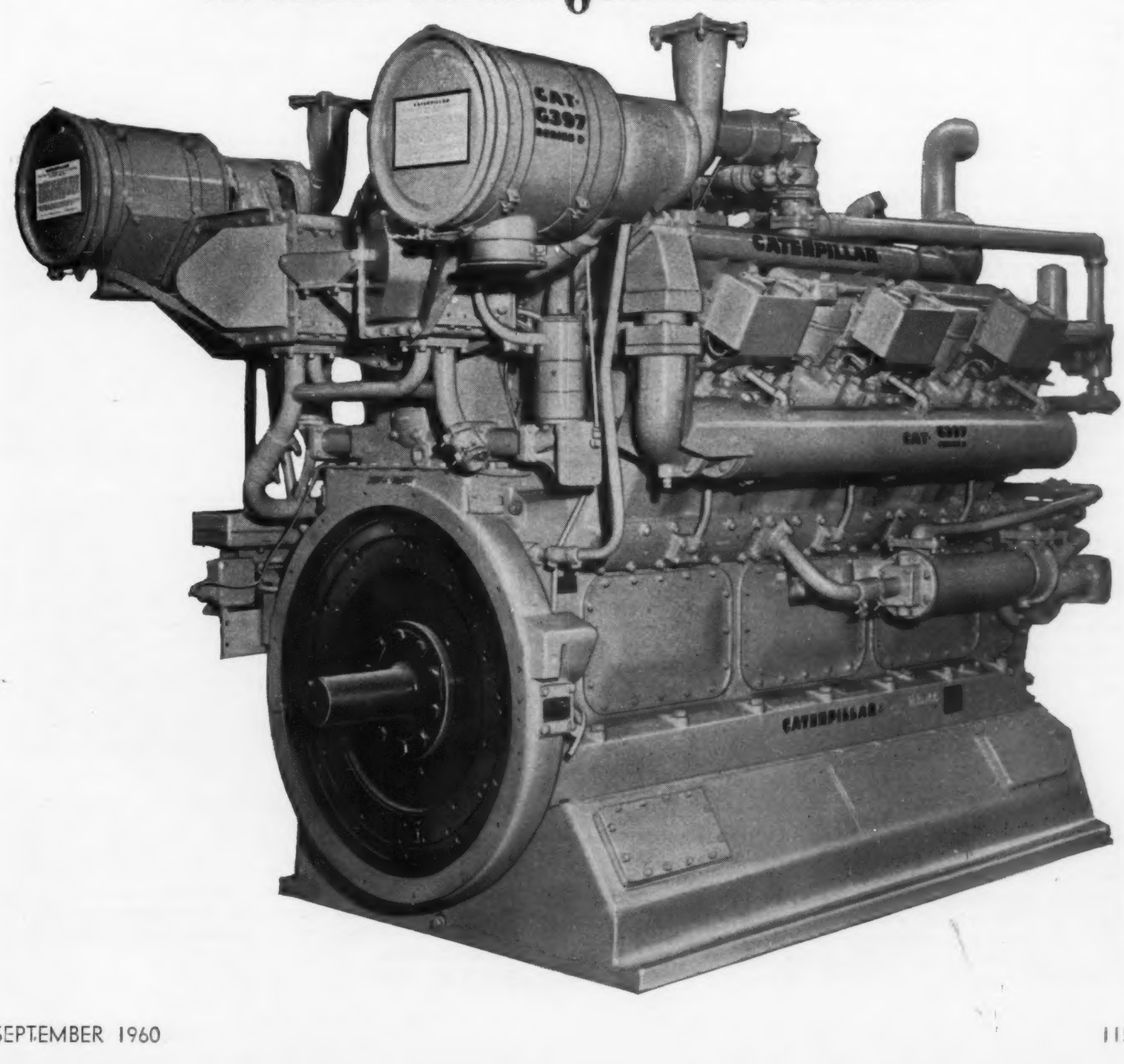
Caterpillar's use of a basic diesel engine in developing its natural gas engine gives tremendous added load carrying ability. The higher compression ratio of 10.5:1 allows increased horsepower output and fuel economy . . . and increases the life of the Cat Engine by many thousands of hours over more conventional designs.

The design of these gas engines permits operation well within the peak pressure load, continuously at full horsepower, *without derating.* And the low tension ignition system means longer spark plug life.

These Natural Gas Caterpillar Engines have proved themselves in the field for many other uses . . . for standby power, pipeline and irrigation pumps, etc. . . . and do give this same economical performance to your air conditioning jobs.

For full technical information, call your local Gas Company, or write to Caterpillar Tractor Co., Peoria, Illinois. *American Gas Association.*

FOR COOLING & HEATING GAS IS GOOD BUSINESS!



CLASSIFIED ADVERTISING

RATES—Classified advertisements at this heading are inserted in 8-point type at the rate of $1.00 per line or fraction thereof, including heading and address. Eight words to the line average. Box number address counts as one line. Minimum insertion charge, 5-line basis. Maximum insertion 10 lines. Prices are net, no discounts. Box number replies promptly forwarded without charge. Available Engineers insertions up to 60 words for Full and Associate members, and Affiliates are carried free.
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NO PROOFS shown; no free checking copies. (Single copies 50c each with order.)
Address classified advertising or requests for further information to
ASHRAE JOURNAL
62 Worth St., New York 13, N. Y.

OPENINGS

AIR CONDITIONING PRODUCT DEVELOPMENT ENGINEER—Desire a graduate engineer, having 5 yr experience in window and builders units models. Send resume and salary requirements to: Albion Div., McGraw-Edison Co., 704 No. Clark St., Albion, Mich.

EXPERIENCED DESIGN and PROJECT ENGINEER—for position with Midwestern Div. of National Manufacturer of air conditioning, refrigeration, and heating equipment. Radiation and convection heating design experience required. Interesting work available in design and project co-ordination of steam and hot water radiation transfer equipment including combination heating and cooling products in hydronics field. Excellent living conditions in adjacent Lake Michigan resort area. Send resume and salary requirements to Box 984, ASHRAE JOURNAL.

APPLICATION ENGINEER—Need young graduate engineer who is interested in training to perform Application Engineering for progressive Air Conditioning and Heating Company. Experience in this area of work or in sales engineering desirable but not necessary. Work can lead to Sales Engineering position in field or to permanent Application Engineering position at factory. Box 990, ASHRAE JOURNAL.

SALES MANAGER wanted for specialty mechanical line with triple A company. Must be engineer with experience in airflow products. Willing to travel. Present resident Eastern Seaboard. Send resume to Box 994, ASHRAE JOURNAL.

AIR HANDLING ENGINEER needed by well-known leader in pneumatic tube and blower manufacturing. Require M.E. to do research and development, primarily. Inquiring mind and ability to grow with expanding company essential. Write giving details of education, experience, salary requirement, and personal data to Box 996, ASHRAE JOURNAL.

REFRIGERATION ENGINEER—Experienced in all phases of developmental work preferably in the fractional horse power range wanted. Outstanding opportunity with a leading commercial refrigerator manufacturer 30 miles south of Albany, N. Y., salary open. Progressive management, excellent benefit program. Write fully, in confidence stating experience and salary required. Box 998, ASHRAE JOURNAL.

AVAILABLE

AIR CONDITIONING and HEAT PUMP ENGINEER—25 yr experience, 3 yr college. Strong and broad background with major manufacturers. Qualified in sales, application and service engineering, technical writing and training programs, architect, engineer and distributor contacting. Mechanical contracting experience. Desires position where mature age and background can be utilized to mutual advantage. Resume on request. Box 979, ASHRAE JOURNAL.

CHIEF MECHANICAL ENGINEER—Present position includes responsibility for design and production efficiency of large department of heating, air conditioning and plumbing engineers, extensive client contact, and construction supervision. Excellent administrative record. 12 yr experience. Desire transfer to East Coast or vicinity to similar responsible position offering opportunity for professional and financial growth. Box 989, ASHRAE JOURNAL.

MECHANICAL ENGINEER—PE, member ASHRAE, 20 yr experience in air conditioning, heating, ventilating, and plumbing. 12 yr consulting engineer. Experience includes high velocity, absorption, steam turbine drive and all phases of conventional systems in all types of buildings including many government agencies and other special or complicated buildings and/or designs. Box 991, ASHRAE JOURNAL.

AIR CONDITIONING ENGINEER—member ASHRAE, age 36, Dutch, residing in Holland, desires position in Air Conditioning field. Will relocate. Educated as electrical engineer, tropical experience in East and West Indies in sales, design, application, installation, distributor, service, engaged in consulting work for air conditioning and refrigeration systems. Box 992, ASHRAE JOURNAL.

MECHANICAL ENGINEER—member ASHRAE. 30 yr outstanding experience in application engineering, installation, maintenance and standardization of air conditioning and refrigeration. Able public speaker and correspondent, successful organizer. Available for challenging assignment in sales promotion, dealer or user education in east. Age 59, married, excellent health. Income requirement modest for right assignment. Resume on request. Box 993, ASHRAE JOURNAL.

ENGINEER-EXECUTIVE—Air Conditioning and industrial, commercial refrigeration. Engineering graduate, with extensive practical and executive experience in development, manufacturing and application of products in these fields. Desires connection with small organization in position for expansion with new products and technical-manufacturing direction. Box 995, ASHRAE JOURNAL.

DESIGN ENGINEER—in heating and ventilating installations, British schooled, 7 yr experience, immigrating to Woosters, Ohio, area. Qualified in air conditioning design. Box 997, ASHRAE JOURNAL.

SALES ENGINEER—B.S. in Building Construction—Heating, Plumbing and Air Conditioning major. 26 yr broad experience including design, supervision, purchasing, sales and management. Heaviest experience—Warm Air Heating & Air Conditioning, commercial and residential. Age—49. Excellent health. Married. Will relocate. Desire connection with progressive company with opportunity for growth. Box 999, ASHRAE JOURNAL.

VENTILATION ENGINEER-ESTIMATOR—BSME, age 39. 12 yr experience industrial dust and fume control and commercial ventilation design and cost estimating. Presently head medium sized sheet metal shop that fabricates and installs industrial and commercial air handling systems, also production type work. Management ability. Preference New England but willing to relocate. Box 101, ASHRAE JOURNAL.

The First National City Bank of New York

1,500,000 Square Feet of Gross Floor Space

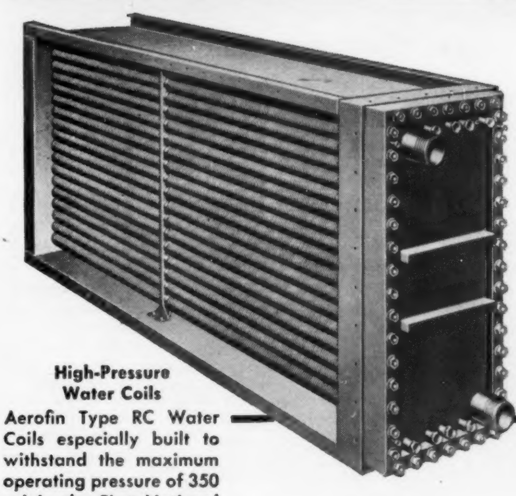
Carson & Lundin and Kahn & Jacobs
Associated Architects

Meyer, Strong & Jones
Mechanical Engineers

George A. Fuller
General Contractor

Raisler Corporation
Air-Conditioning Contractor

AEROFIN INSTALLED



High-Pressure Water Coils
Aerofin Type RC Water Coils especially built to withstand the maximum operating pressure of 350 psi in the First National City Bank's new building.

Modern smooth-fin design of Aerofin coils permits ample heat-exchange capacity in limited space—permits the use of high air velocities without turbulence or excessive resistance.

Aerofin performance date are laboratory and field proved. You can specify Aerofin coils at full published ratings.

AEROFIN CORPORATION

101 Greenway Ave., Syracuse 3, N.Y.

Aerofin is sold only by manufacturers of fan system apparatus. List on request.

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Why Does

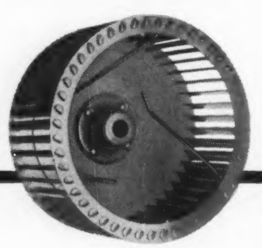
International

OIL BURNER COMPANY

use Revcor

"R" DESIGN BLOWER WHEELS?

because...



Type "R" Blower Wheels have given us maximum air delivery with quiet operation and the mechanical strength required for utilization in forced-air heating and air conditioning equipment.

Revcor

Blower Wheels and Fan Blades Deliver More Air... More Efficiently... Most Quietly!

WRITE FOR FREE BROCHURE or send specifications to

Revcor, INC.

ENGINEERS • MANUFACTURERS

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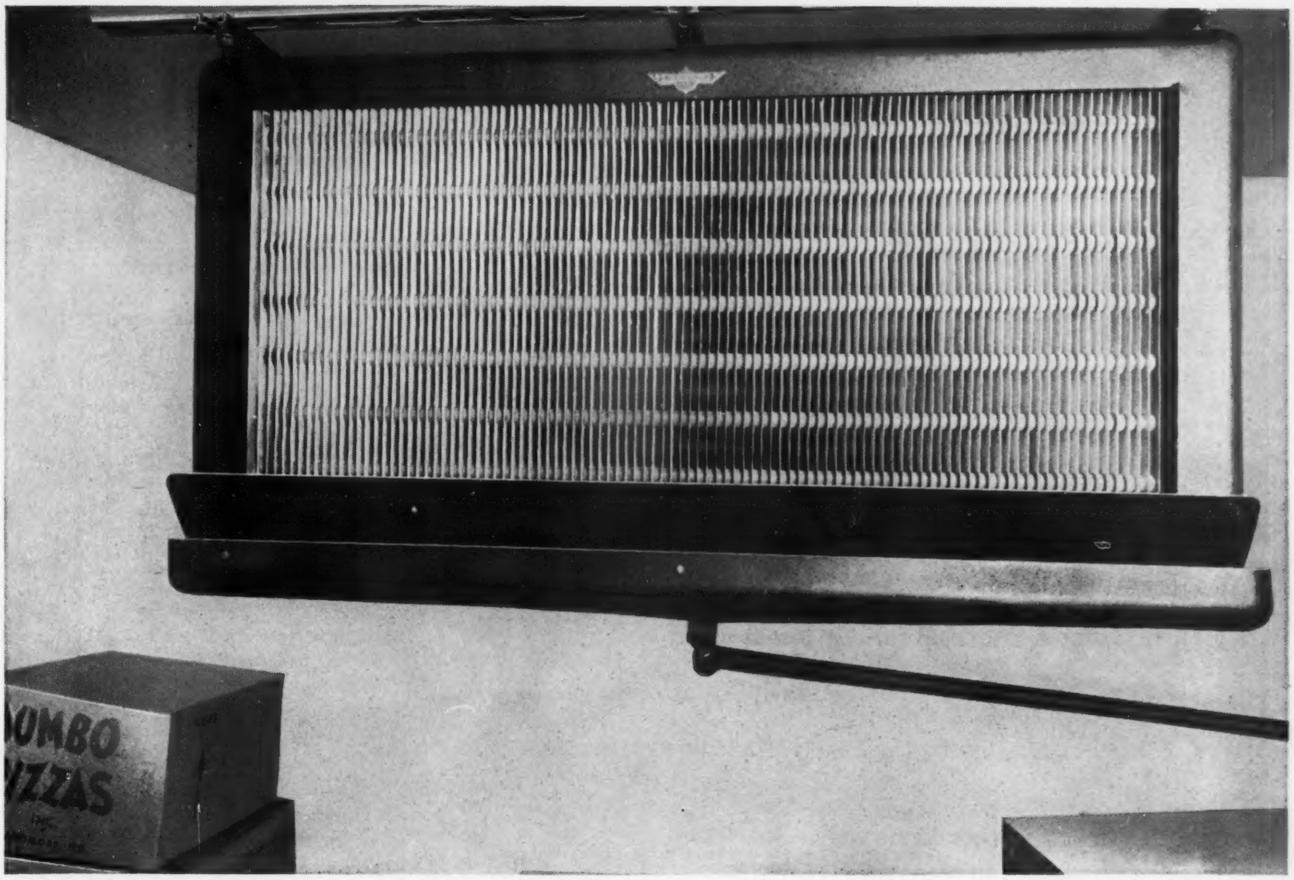
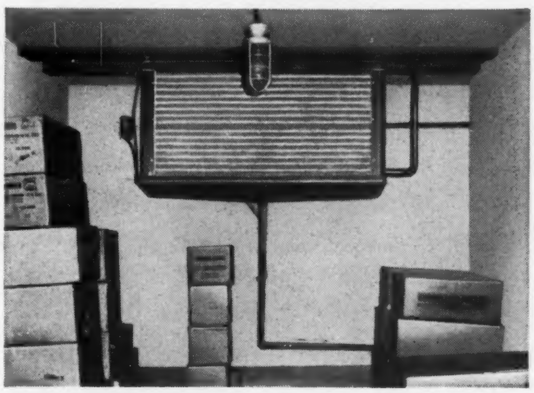


You'll like LARKIN for zero and lower!



Low initial cost, simplicity of installation, good service—these are the points that earned LARKIN Low Temperature Humi-Temps a reputation throughout the free world.

HOT-GAS DEFROST

Standard LT units, mullion units and wall units are available with LARKIN's patented Frost-O-Trol® Hot-Gas Defroster. It is simple, effective, fool-proof, completely automatic. A factory-installed metering orifice prevents slugging of refrigerant into compressor—making extra tanks, reversing valves or re-evaporators unnecessary.

ELECTRIC DEFROST

Sealed electric heaters embedded in the coil defrost by radiation, conduction and convection in the LARKIN ELT—Electric Defrost Low Temperature Humi-Temp. Top efficiency, low operating cost are assured.

QUALITY FEATURES

- Minimum temperature rise during defrosting
- Adjustable defrosting time and frequency
- No excess heat or moisture load
- Lower operating costs
- Higher efficiency of evaporator unit
- Melts frost from inside out — heat applied throughout entire evaporator
- Simple, low-cost installation
- Drip pan is electrically heated by a carbon impregnated, water-proof, molded pad — assures positive drainage of melting ice and water — prevents freezing
- Larkin patented Cross Fin coil — staggered electro tin-plated tubes
- Heavy gauge aluminum case
- Self-locking nuts; vibration-proof assembly
- Standard motors with thermal overload protection

WATCHDOG OF THE NATION'S FOOD AND COMFORT ☆ LARKIN ☆

See your wholesaler, or write for bulletins 1032, 1055, and 1056

LARKIN COILS INC.

519 Memorial Drive, S.E. • P. O. Box 1699 • MUrray 8-3171
ATLANTA 1, GEORGIA

USEFUL INFORMATION on

Activated Charcoal

for High Percentage Air Recirculation and Odor Control

Bring your files up to date with these bulletins on activated charcoal. Just clip this ad and mail it to us.

- ☐ Activated Charcoal for Air Purification
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- ☐ Air Purification by the Black Magic of Activated Charcoal
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- ☐ Hospital Odor Control
- ☐ Weigh Odor Control Methods Carefully
- ☐ Air Purification with Activated Charcoal Filterfolds

Activated charcoal acts as a positive molecular sponge which adsorbs gases, vapors, irritants, toxic substances and smog. It enables you to engineer for high percentage air recirculation at low cost.

These and many other bulletins on all applications of activated charcoal are available to you. Give us the details of your application and we will supply specific data and samples.

We supply a complete line of activated carbons for every purpose; design and prefabricate air and liquid purification, separation and recovery systems. Barnebey-Cheney, Columbus 19, Ohio.

Barnebey Cheney

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W

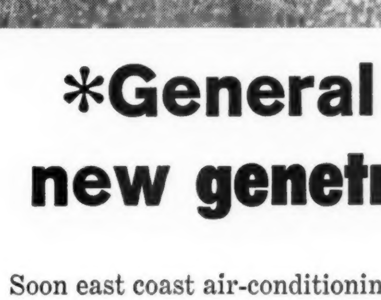
*General Chemical announces a new genetron® plant in Elizabeth, N. J.

Soon east coast air-conditioning and refrigeration wholesalers and original equipment manufacturers will be "next door" to a new source of "Genetron" Super-Dry Refrigerants. General Chemical has started construction of large new "Genetron" manufacturing facilities at its Elizabeth, N. J. works.

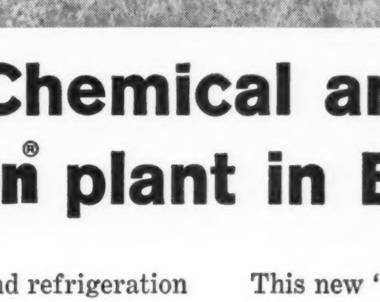
This will be the third "Genetron" plant, supplementing those in Baton Rouge, Louisiana, and Danville, Illinois, and increasing our over-all production capacity by more than one third.

This new "Genetron" plant is another example of General's efforts to serve the growing needs of the air-conditioning and refrigeration industry and will reflect the advanced manufacturing and process control techniques which have grown from General Chemical's leadership in fluorine chemistry.

"Genetron" Super-Dry Refrigerants are stocked by all leading wholesalers coast to coast. Insist on the best . . . insist on "Genetron" Super-Dry Refrigerants from *your* wholesaler.



BATON ROUGE, LA.—From this giant fluorochemical center shipments of "Genetron" Super-Dry Refrigerants speed to wholesalers and equipment manufacturers and to our "Genetron" stock points throughout the nation.



DANVILLE, ILL.—General Chemical's Danville plant assures Midwest users of a dependable supply of "Genetron" Super-Dry Refrigerants. This plant also backs up supply to General Chemical's nationwide network of stock points.

genetron®

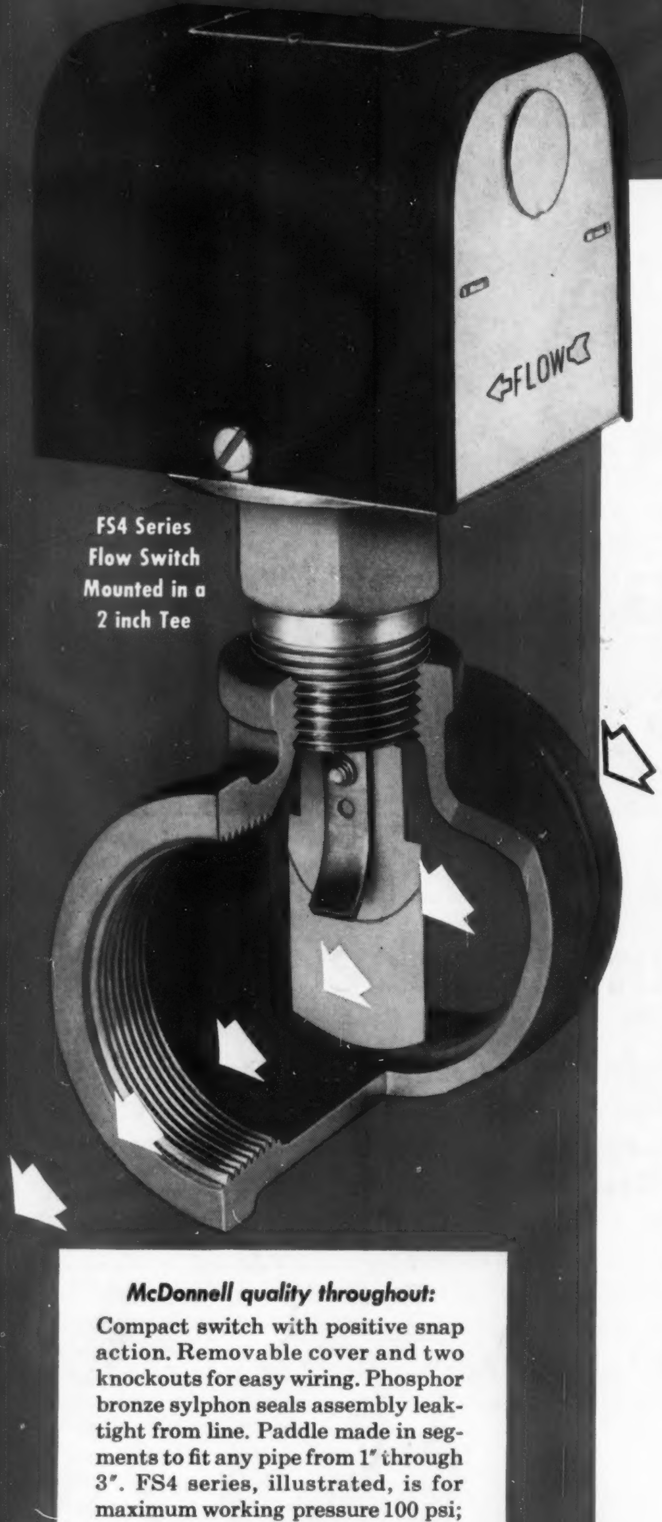
super-dry
refrigerants

Allied Chemical

GENERAL CHEMICAL DIVISION

40 Rector Street, New York 6, N. Y.

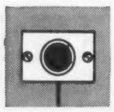
McDONNELL
Flow Switches



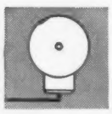
FS4 Series Flow Switch Mounted in a 2 inch Tee

Do you know how many jobs these switches can do?

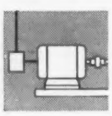
Look at the FS4 Series Flow Switch illustrated here. What you see is a compact, well-built switch that either makes or breaks a circuit (as required) when liquid flows or stops flowing. Yet in this versatile device you have both the most economical way and the most positive way of starting or stopping a signal, an alarm, a motor, a metering device—anything electrically operated. Just to highlight a few uses:—



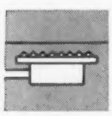
to actuate a signal light—signal an attendant to make the right moves in operating valves, pumps and the like—signal him when flow stops in a water cooled compressor, water cooled bearing and so on.



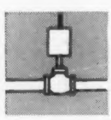
to sound an alarm—when flow stops in a process system or in any water cooled devices.



to start or stop motors—start pumps in sequence in multiple stage flow systems; start standby pumps; stop automatically controlled units if cooling water system fails; stop compressors in cooling systems when flow stops. These are *control* functions, and almost endless.



to start or stop automatic burners—start a booster heater when water draw occurs; stop burner if flow is improperly retarded; make sure of circulation in a boiler before burner is permitted to start.



to actuate metering device—open valve in chemical feeder line; start mixing in secondary line whenever flow starts in primary line.

Think it over! Some of these uses may suggest some related problem the FS4 can solve for you right now. Notice the facts about its construction and service range opposite.

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Compact switch with positive snap action. Removable cover and two knockouts for easy wiring. Phosphor bronze sylphon seals assembly leak-tight from line. Paddle made in segments to fit any pipe from 1" through 3". FS4 series, illustrated, is for maximum working pressure 100 psi; maximum temperature, 300° F., in types as follows:

FS4-3 Single pole, double throw switch. Opens and closes two separate circuits with flow. Closes and opens same two circuits with no flow.

FS4 Closes with flow, opens with no flow.

FS4R Opens with flow, closes with no flow.

Underwriters' Listed

● Model E-2 available for larger pipe sizes and pressures to 150 psi.